Master thesis for the Master of Philosophy in Environmental and Development Economics degree

The Role of Environmental Civil Liability in Regulation of Marine Oil Pollution in Norway

Ekaterina Denisova

Department of Economics

Faculty of Social Sciences

UNIVERSITY OF OSLO

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Contents

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I am responsible for the views expressed here, and any flaws remain mine alone.

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List of Symbols

x	level of precaution
p(x)	probability of an accident
D(x)	cost of damage
h	magnitude of harm
C(x)	cost of precaution
n	number of firms in an industry
y	firm's output level/ level of assets
S	industry's output
P(S)	industry's demand
C(y)	cost of producing output
q	probability of suit
s	standard of care
L	magnitude of liability

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It's not enough that we do our best;
sometimes we have to do what's required.

Sir Winston Churchill (1874-1965)

1. Introduction

1.1. Background of the paper

Oil and gas remain the critical energy sources that power industry and transportation and drive today's global economy. The historical development of the petroleum industry has been remarkable for its high dynamics, rapid technological progress and wide geographical expansion. The most dangerous and widespread companion of the offshore activities is marine oil pollution. It has become a source of worry worldwide because of the growing energy needs and the increasing sea-borne transport of oil and oil products. Current national and international measures for accident prevention and mitigation of their consequences are often not effective enough.

The improvement of the regulatory measures is complicated due to the variability and unpredictability of environmental effects that spilled oil produces on the marine environment. The choice of specific ways of managing pollution (control, prevention, regulation) depends on the nature of environmental impact (long-term/ short-term, regular/ accidental) caused by each particular activity. Regular discharges of wastes (water produced to the surface along with oil during drilling) are much easier to bring under control because the relationship between pollution sources and damage is clear and certain. Accidental discharges (blowouts of oil and gas when control over well pressure is lost during drilling, unintentional oil spills during tanker accidents: running aground, collisions with other vessels) present a more difficult task because they are associated with risk. The concepts of hazard and risk are very important in the design of the optimal responses to accidental pollution. *Hazard* means the combinations of properties and characteristics of a material, process or situation that are able to harm and cause a damage of ecological, economic or any other nature (Patin 1999, p. 104). *Risk* can be defined as the probability of realization of this hazard under specific conditions within a certain period of time (Somerville and Shirley 1992, p. 644). One of the regulator's goals is to manage risk in such a way that a socially optimal level of risk is achieved.

1.2. Oil pollution management in Norway

Awareness of domestic and international environmental issues has long been high in Norway. As far as marine oil pollution is concerned, Norway is exposed to coastal water pollution arising from such strategically important sectors as the petroleum industry and oil transportation. The petroleum industry contributes almost 40 per cent of the government's revenues and 26 per cent of Norway's GDP[1]. Presently, there is a declining trend in oil production. According to forecasts from the Norwegian Petroleum Directorate presented in Facts 2007[2], oil production on the Norwegian Continental Shelf is estimated to continue to decline until 2011 which is primarily due to higher expected production of gas (**figure 1,** p. **52)**. Apart from the Ekofisk oil field blow-out in1977, Norway has had very few sizable oil spills. There are three main sources of regular discharge of oil-contaminated water from the petroleum industry: produced water, displacement water and drainage water. The total discharge of oil to sea was 2717 tonnes in 2006 which made 0, 0024% of the total oil production[3]. Accidental discharges of oil in 2006 amounted to 103 tonnes, or 3, 8% of the total discharge of oil[4]. Further reduction in volume of produced water containing oil is expected by the NPD in the future (**figure 2**, **p. 52**). According to the Norwegian Coastal Administration, oil pollution caused by tanker oil transportation does not give any reason for environmental pessimism either (**figures 3 and 4, p. 53**). It is evident that marine oil pollution in Norway is under the authorities' control. However, the risk of a serious oil spill and its effects on fragile ecosystems and fishing activities should not be underestimated.

1.3. Problem definition and composition of the paper

The focus of this paper will be mainly on regulation of risky activities that may cause oil pollution. This paper is an attempt to make a positive economic analysis of environmental civil liability for marine oil pollution in the offshore oil production and oil shipping sectors. Liability for bunker oil spills is not studied in the paper.

The main problems addressed in the thesis are:

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[1] OLF Miljørapport 2006, www.olf.no/publikasjoner/miljorapporter, p.7
[2]Fakta Norsk Petroleumsverksemd 2007,
www.npd.no/Norsk/Produkter+og+tjenester/Publikasjoner/Faktaheftet/Faktaheftet+2007/coverpage.htm

[3] According to OLF Miljørapport 2006, p. 16, the total production of oil in 2006 was 137 million Sm^3, or approximately, 115 million tons.
[4] OLF Miljørapport 2006

Does Norwegian oil spill-related legislation have an implicit economic logic? To what extent does economic theory help explain and improve the existing legal rules?

There are four parts in the paper. Part 2 presents a theoretical framework for the analysis of environmental liability. In section 2.1 we make use of a standard model of law and economics developed by S. Shavell and introduce two main liability rules. In section 2.2 we study the efficiency of the prevention and the activity level under these legal rules. Section 2.3 discusses whether environmental liability should be supplemented by other policy measures, in particular, direct regulation. A critical analysis of the literature on this issue is provided. Part 3 is analytical. In section 3.1 we mention the most important conventions that influenced Norwegian environmental law. Section 3.2 explores whether the legal regimes in the Norwegian petroleum industry and oil shipping sectors ensure efficiency from the economic point of view. This discussion is continued in section 3.3, but with regard to such fundamental principles of environmental law as polluter pays principle, precautionary principle and best available technology. Finally, in part 4 the conclusions are drawn.

2. Theoretical Analysis of Policies Designed to Regulate Marine Oil Pollution

Policy instruments of risk management involve the private market (insurance), decentralized regulation (litigation) and direct regulation of risky activities (safety standards). Depending on their purpose and function, policy measures can be divided in two groups: some of them are designed to prevent oil spills (safety regulations, monitoring the level of care) and others are used to reduce the damage caused by an accident (installation of backup equipment, financial coverage for the victims). We call the first group of measures ex-ante instruments and the second group ex-post instruments. According to this classification, direct regulation can be looked upon as an ex-ante mechanism while insurance is an ex-post one[5].

Liability law deserves a special consideration. It allows accomplishing two policy goals with one policy instrument which indicates its strength and weakness. From an economic perspective, different instruments should be used to meet different targets (Johansen 1965, pp. 8-9). As an ex-post instrument, liability law provides compensation schemes to victims of pollution. The other goal of liability is to induce the polluter engaging in risky activities to

[5] There is an ex-ante element in insurance as the risk premium a polluting firm pays to the insurer can be viewed as a part of the firm's prevention effort. The amount of insurance chosen by the polluter reveals his evaluation of risk. Another ex-ante element of insurance is organizing funds providing compensation to victims of oil pollution, though oil producers are often unwilling to contribute to such funds.

take the socially optimal level of precautions. Thus, civil liability operates as a threat deterring potential accidents and resembling the ex-ante techniques.

There are two criteria that determine the choice of policy instruments from the economic point of view: cost efficiency and the efficiency in achieving targets. Cost efficiency is the corner stone of many economic models. By the optimal penalty model of Becker (1968), the optimal level of crime in the society is reached provided the equilibrium condition is fulfilled where the marginal cost of enforcement equals the marginal benefit of crime reduction. The regulator must bear this result in mind when choosing an appropriate policy instrument. Cohen (2004) suggests a couple of refinements of Becker's model in the context of marine oil pollution. Both of them are related to the optimal enforcement level. Firstly, optimal enforcement is not only determined by the cost of enforcement measures, but also by the involved parties' degree of negligence. Though oil spills may occur randomly without the polluter's intention (for example, due to force majeure) unlike traditional criminal activity, there is often an element of negligence in each accident. Even if an oil spill is out of a tanker-owner's control, the damage of the spill will be larger than it would otherwise be if the required backup containment equipment had been installed on a tanker. Secondly, optimal enforcement is based on a trade-off between preventive measures and measures to reduce damage of a spill once it has occurred. In some cases actions taken in order to attenuate the consequences of oil spills are more preferable than preventive measures from the society's point of view. The trade-off between the two policy goals can be avoided when marine oil pollution is regulated by means of liability.

2.1 Shavell's model

There are two basic types of liability: fault-based liability (negligence) and non-fault-based (strict) liability. Under strict liability, injurers must pay for all accident losses they cause no matter how careful they are[6]. Under the negligence rule, an injurer is held liable for the accident losses he causes if he was negligent, or otherwise his level of care was less than the socially optimal amount. The optimal amount of care, or the legal standard of care, is specified by the courts.

[6] It is not true when strict liability is supplemented by contributory or comparative negligence which will be discussed later.

Let us present a simplified economic perspective on liability (Shavell 1980, Shavell 2004, pp. 177-207) with one polluter and one victim. Traditional economic analysis of the liability rules is based on the following assumptions:

1. The polluting firm is risk neutral.
2. The polluter's total cost of precaution *C(x)* and the marginal cost *C'(x)* are increasing in the level of precaution taken by the polluter, *x*.
3. The expected damage cost *E[D(x)]* and the marginal expected damage cost *E[D'(x)]* are decreasing in *x*. The expected damage cost can be also written as $p(x) \bullet h$ where *p(x)* is the probability of an accident and *h* is the harm the accident causes. We assume $\frac{\partial p(x)}{\partial x} < 0, \frac{\partial^2 p(x)}{\partial x^2} > 0$. The level of care taken by the victim has no impact on the probability of an accident.
4. The legal standard *x* is set at an economically efficient level, *x**.
5. The polluter behaves as a rational cost minimizer.

Suppose that social welfare *W* is given by $W(x) = -(C(x) + p(x)\, h)$. The *socially optimal level* of precaution *x** is the solution to the following problem:

$$x^* \in \arg\max \left(-C(x) - p(x) \bullet h \right) \qquad (1)$$

Under the negligence rule, if the injurer takes the optimal level of precaution, *x**, he is not negligent and must pay only the cost of precaution *C(x*)*. The injurer takes no more than due care because it involves additional costs. He will not take less care than *x** as he will pay the sum of the precautionary cost and an expected damage liability.

Under the strict liability rule, the injurer's profit maximization problem is the social problem (1). He will always choose the efficient level of care as he will be liable for the damage regardless of how much care he takes. The injurer's choice of care is illustrated by **figure 5**, p. 54, where the total cost of care under negligence and strict liability is represented by the red and blue curves respectively.

2.2. Criteria for assessing the effectiveness of the strict liability and negligence rules

From the cost efficiency point of view, both rules result in the same, socially optimal behaviour- they both achieve the socially desirable level of precaution. One can meanwhile compare both forms of liability using some other important criteria.

2.2.1. There is no discontinuity in the total cost function under strict liability because the injurer's cost fully coincides with the total social cost. This is a crucial point when we deal with limited liability which deserves a thorough consideration and will be discussed later. Besides, the total cost under negligence is lower than under strict liability (from **figure 5** $TC^{NR} < TC^{SL}$), which makes the former standard preferable from the polluter's perspective.

2.2.2. To apply strict liability a court needs only to know the magnitude of the loss occurred. For negligence to work, a court must in addition ferret out the actual level of precaution and compute the legal standard x^*. Establishing x^* is an expensive process because a court needs to know the cost and effectiveness of taking different levels of care in reducing the probability of accidents. Hence, the negligence rule provides a lower level of net social welfare because it requires additional resources to determine the standard of care, the cause of an accident etc.

Additional informational resources are necessary under negligence when the regulator intends a liability regime to control not only the level of care but other variables such as a firm's output, a firm's scale of research in safety technology etc. This is one more argument in favour of strict liability. In some cases it is equally important for the authorities to control a firm's investment in precaution and its activity level because an increase in production will typically raise risk of accident and expected accident losses. An example is regulation of activities generating pollution where pollution can be viewed as a by-product.

Under negligence, the courts get into difficulties while formulating the negligence standard in terms of other variables, like firms' output. The efficiency of expanding the due care standard is addressed in Shavell (1980) and Polinsky (1980). Shavell points out that any variables omitted from the standard would be inappropriately chosen. The classical example is a firm's production scale.

The model developed by Shavell (1980) is built on the following assumptions:

- both polluters and victims are risk neutral,
- the legal system operates with zero administrative cost,
- the social optimum is defined by the welfare criterion with no concern for distributional effects.

The actors (polluters and victims)' behaviour depends on the nature of the accident and on the type of activity. By *unilateral* accidents Shavell (ibid) means the situations in which only the

polluter's behaviour affects the probability of accident. In *bilateral* cases both potential victims and injurers may influence the risk of accident. Injurers engage either in a *non-market activity* or are sellers of a product in a *competitive market* so that the zero profit condition holds. We find it appropriate to briefly discuss the efficiency of the liability rules in a non-market setting. The main results in Shavell (ibid) are summarized in **Table 1**, p. 8.

In a non-market setting when a polluter exerts *unilateral* influence on the accident risk negligence is inefficient. Given that a polluting firm has taken due care, it will not be held liable for pollution damage. In deciding how much to produce (and to pollute) a potential injurer will be solely guided by his personal benefits and will tend to choose a too high activity level. Under strict liability an injurer pays for damage whenever an accident occurs. The rule makes polluters consider both the effect of their output level and care level on the probability of accidents. Both variables will be set at the socially optimal level.

In *bilateral* cases no rule induces efficient behaviour. Under the negligence rule, an injurer behaves in the same way as in a unilateral case taking the optimal level of precaution and producing too much. By contrast, victims' choices of care and output level are efficient. Under strict liability with contributory negligence[7] the outcome is also inefficient[8]. While the injurer is motivated to produce optimally and take optimal precaution, the victim behaves inefficiently. The rule incentivizes the victim to take due care while the control of the victim's output level is beyond the rule. In a non-market case the choice between strict liability and negligence is a choice between the lesser of two evils. It depends mainly on whose activity it is more important to bring under control. If the injurer's activity puts the society to higher risk, which is often the case, it is strict liability with contributory negligence that is preferable.

Polinsky (1980) develops Shavell's idea by proving that in case of environmental pollution it is also important to control the number of polluting firms in an industry in the long run[9]. The efficient due care standard is the one which incorporates each firm's level of care, level of activity and the size of the industry. Hence it is not a standard for a single firm but a standard for the whole industry. Polinsky's model is built on the same assumptions as the classical

[7] Under contributory negligence the victim's claim on damages is wholly reduced, under comparative negligence the claim is reduced only partially (Haddock and Curran 1985, pp. 50-51).
[8] Strict liability with a defence of contributory negligence is preferred to strict liability without the defence. Since a victim influences accident risk in bilateral cases he should be given incentives to exercise due care as well. Under strict liability without the defence neither victims' activity nor their care level are efficient.
[9] These two papers differ from the insight in Brown (1973) and Diamond (1974) who treat the level of activity as fixed.

Table.1
Efficiency of liability rules in dealing with unilateral and bilateral accidents (Shavell 1980)

	Unilateral accidents	Bilateral accidents	
I. Non- market case	Strict liability of injurer	No optimal rule	
II. Market case			
A. No contractual arrangements between injurers and victims (sellers vs. strangers)	Strict liability of injurer	No optimal rule	
B. Contracts between injurers and victims (sellers vs. customers/ employees)		*Non-durable goods*	*Durable goods*
1. Customers have perfect information about each seller's risk	- Negligence rule - Strict liability - No rule	- Negligence rule - Injurer's strict liability with contributory negligence on customers - No rule	- Negligence rule - No rule
2. Customers know only the average risk	- Strict liability - Negligence rule	- Negligence rule - Strict liability with contributory negligence	Negligence rule
3. Average risk is unknown	Strict liability	Strict liability with contributory negligence	No optimal rule

model[10] with a qualification that an industry is composed of several competitively behaving firms[11] .

It is demonstrated that the socially optimal number of firms and optimal prevention and production become feasible only under strict liability. The outcome is the same in the market and non-market cases. There are *n* identical firms in an industry. Each firm's cost of

[10] The assumptions in section 2.1.
[11] In Shavell (1980) an industry is viewed as one competitively behaving firm whose harm depends on care and activity levels.

producing y units of output is $C(y)$ with $C'(y)>0$ and $C''(y)>0$. A firm's cost of taking x units of care $C(x)$ is x. The environmental damage caused by a firm is $D(x)$. $P(S)$ is the industry's inverse demand with the aggregate output $S=ny$.

The social optimum in the long run is defined by the efficient levels of x, y and n which maximize social welfare W[12]:

Max $W=\int_0^{ny} P(S)dS - nC(y) - nD(x) - nx$ w.r.t. x, y and n

y^*, x^* *and* n^* are obtained from the following first order conditions:

$$\frac{\partial W}{\partial y} = n \cdot P(ny) - nC'(y) = 0$$

$$P(ny) = C'(y) \qquad (2)$$

$$\frac{\partial W}{\partial x} = -n \cdot D'(x) - n = 0$$

$$-D'(x) = 1 \qquad (3)$$

$$\frac{\partial W}{\partial n} = y \cdot P(ny) - C(y) - D(x) - x = 0$$

$$P(ny) = \frac{C(y) + D(x) + x}{y} \qquad (4)$$

Under *strict liability* each firm's maximization problems in the short run and in the long run are identical:

$$Max_{x,y}\{Py - C(y) - D(x) - x\}$$

The first order conditions (2) and (3) are satisfied. Besides the zero profit conditions should hold in the long run:

$P(ny^*)\, y^* - C(y^*) - D(x^*) - x^* = 0.$ (5)

It is equivalent to (4) and ensures the optimal industry size n^*.

Under negligence, a firm's maximization problem is:

$Max_{x,y}\{Py - C(y) - D(\bar{x}) - \bar{x}\}$ where $\bar{x}$ is the due care standard.

Supposing that the standard $\bar{x}$ is set at the efficient level x^*, (2) holds so that a firm produces y^*. The firm's zero profit condition is altered: given $\bar{x} = x^*$, the firm is not liable for damage:

$P(ny)\, y - C(y) - x^* = 0$ (6)

[12] In the short run n is fixed, and the due care standard prescribes only x^* *and* y^*.

The equilibrium values of y and n under negligence are y^0 and n^0. It is shown in section 1 of Appendix that $y^0<y^*$ and $n^0>n^*$. The negligence standard leads to a too low output by each firm, a too low market price and the industry's expansion in the long run.

It seems logical to conclude the discussion of the due care standard by asking whether such important variables as the level of activity and an industry's size can in principle be included in the due care standard given the negligence regime. It turns out to be problematic because it is beyond the courts' competence to decide on each firm's and each industry's output. What the courts can determine is whether a firm is negligent with respect to its production activity. By contrast, one cannot hold any firm responsible for the number of firms in the industry as Polinsky (1980) proves. In cases when the regulator's goal is to control not only the care level, but also polluters' output the use of strict liability is advantageous because it allows avoiding difficulties in formulating the due standard.

2.2.3. However, one cannot help mentioning the advantage of negligence: the courts are less burdened as there are only accidents in which the injurer has been negligent that are taken to court. Therefore, negligence is likely to impose a lower administrative cost than strict liability. Even assuming that the number of accidents is unchanged when negligence is replaced by strict liability, the latter leads to a higher number of claims and a higher procedural cost because the scope of liability is greater than under negligence. A larger scope of liability tends to increase the expected value of the victim's claim and his chances to succeed in a trial (Hirshleifer and Osborne 2001) providing the victim with stronger incentives to sue the injurer. However, the administrative cost of negligence may be high in cases where unavoidable accidents constitute a small proportion of the total (Posner 1977, p. 442).

2.2.4. The negligence rule is more efficient than the strict liability rule in cases of:

a) limited liability,

b) injurer's insolvency or a possibility of the injurer's escape from suit

because the former better ensures that the injurer takes the optimal level of care[13].

Limitation of liability is a controversial issue. On the one hand, financial caps are introduced to prevent companies from going bankrupt and they make it possible for ship-owners to shift the risks to insurance companies. In case of no limitation, it would be difficult for the insurers to assess the magnitude of the risks and set an appropriate premium. On the other hand,

[13] One way to avoid diluting incentives to take care may be to require compulsory insurance.

financial limits act against the polluter-pays principle and dilute economic incentives for prevention. It has been pointed by many economists (Cohen 1987, Harris and Raviv 1991, White 1989) that limited liability makes risk neutral agents risk-loving. The injurer is willing to accept more risk and consequently to invest less in prevention as he will bear only a part of the damage cost when an accident occurs. Though higher penalties can deter potential polluters from excessive engaging in harmful activities, they increase the probability of bankruptcy which decreases incentives to take care. The negligence standard can perform better for this trade-off than strict liability. The injurer is punished only when his effort was inefficient. This reduces the expected penalty size and the probability of bankruptcy without creating an off-setting incentive to reduce care.

Polluters' insolvency or a positive probability of escape from suit (for example, when the victim's cost of suing the injurer is high) [14] discourages polluters to take proper care as well. We provide a formal analysis of how limited liability and/or probability of escape from suit affect potential injurers' incentives to take preventive measures. The analysis is based on Schmitz (2000), Shavell (1984b) and Summers (1983). We use the same set-up as in section 2.1 [15].

For simplicity we assume that $p(x) = 1-x$. Let x, h and q (probability of suit) $\in [0, 1]$. We assume that magnitude of harm is known only to the injurer, the regulator knows only its cumulative distribution $F(h)$.

The socially optimal amount of care can be calculated by minimizing the total cost of care and harm done:

$$\min_x \{C(x) + (1-x)h\} \tag{7}$$

FOC: $$C'(x^*(h)) = h \tag{8}$$

In the optimum the marginal cost of precaution equals the harm caused by the injurer when the accident occurs, and the first-best level of care is determined by $x^*(h)$. It can be shown that $x^*(h)$ is increasing in h.

SOC: $$C''(x^*(h))\frac{dx^*(h)}{dh} = 1$$

[14] Summers (1983) generalizes both cases and refers to them as the problem of disappearing defendant. This problem is also referred to in economic literature as the problem of judgement proof ness (Cohen 1987, Shavell 2004, pp. 230-232)

[15] The assumptions of the classical model from section 2.1 about the polluter's risk-neutrality, probability- based safety technology and the unilateral type of accidents are valid.

$$\frac{dx^*(h)}{dh} = \frac{1}{C''(x^*(h))} = 1 > 0 \qquad (9)$$

When *strict liability* is used, the level of care taken will be lower than the first-best amount because of the wealth constraint (the injurer pays liability h only if $h<y$) and/or because $q<1$. The minimization problem will be:

$$min_x \{C(x) + (1-x)q \bullet min\{h,y\}\} \qquad (10)$$

FOC: $C'(x_{SL}) = q \bullet min\{h,y\}$ (11)

The optimal level of care under strict liability is given by $x_{SL}=x^*(q \bullet min\{h,y\})$.

Under limited liability: $h>y$ (suppose that $q=1$)

$C'(x_{SL}) = y < h = C'(x^*(h)) \Rightarrow x_{SL} = x^*(y) < x^*(h)$ by SOC (9)

Under probability of suit: $q<1$ (suppose $h \leq y$)

$C'(x_{SL}) = qh < h = C'(x^*(h)) \Rightarrow x_{SL} = x^*(qh) < x^*(h)$ by SOC (9)

Given the negligence standard is set correctly by a court such that $x_{NR} = x^*(h)$, the *negligence rule* will be more efficient. If $x_{NR} \neq x^*(h)$, neither rule is efficient, according to the model.

Summers (1983) obtains a slightly different result. The author defines the critical level of the probability of suit q_c and proves that as long as $q > q_c$ *negligence* does provide efficiency. The argument is demonstrated graphically in **figure 5, p. 54**. Since $q<1$, the total cost curve *TC* shifts downwards. For $q>q_c$, the injurer still chooses x^* because his total cost curve TC^1 (pink curve) is higher than cost of care $TC^{NR}(x^*)$ under the negligence rule for all values of x. When q reaches some critical level q_c and the total cost equals TC^2 (green curve), the precautionary cost of negligence standard x^* would be higher than the sum of $C(x)$ and the expected discounted damage cost. The new total cost TC^2 is minimized at x^2. For all $q < q_c$ the injurer will take insufficient care, and the negligence rule becomes inefficient.

Under *strict liability*, an injurer with $q<1$ and/or $h>y$ will always choose a lower level of precaution than the optimal amount. There is no critical probability of suit or critical likelihood of insolvency for the injurer since his total cost function is continuous. As q goes to 0, the injurer will take less and less care. Unlike under the negligence rule, the injurer facing the total cost of TC^1 will end up with the care level x^1 and not x^*.

Given the probability of suit $0<q<1$, the injurer will take at least the same, and sometimes more care under the negligence rule than under the strict liability rule. For $q>q_c$ the

negligence rule will be more efficient, while for $q<q_c$ both approaches will result in the injurer's taking the inefficiently low level of care.

2.2.5. In a dynamic setting both strict liability and negligence can be desirable. One can argue that strict liability provides companies with more incentives to invest in R&D to find a better technology that would reduce the probability of accidents (Posner 1977, pp. 138-139). The negligence standard, on the contrary, creates fewer incentives for technological improvements because the optimal level of care depends only on current technology. However, one can also show that the negligence rule does not prevent firms from being innovative. When firms develop a new prevention technology they can renegotiate the standard with the regulator.

2.3 Comparing civil liability with other instruments of regulating oil pollution

2.3.1 Coasean bargaining

The prime issue of the economic literature on optimal regulation is the choice of instruments correcting for externalities. The analysis of economic efficiency of various allocations in the presence of externalities is influenced by Ronald Coase's pioneering contribution (1960). Given the property rights are clearly defined, there are zero transaction costs, perfect information and a costless legal system for enforcing contracts, the efficient outcome will be reached independent of the initial allocation of the property rights. The fact that transaction costs are not negligible and marine environment is not subject to well-defined and clearly established property rights makes the Coase bargaining inapplicable. Marine oil pollution is difficult to control because it affects primarily unowned things (fish, the marine biodiversity etc). In this case the polluter will not be sued and will not bear the full consequences of his hazardous activity. The economic literature on accident law demonstrates that legal rules can remedy externalities associated with oil pollution damage.

2.3.2. Choice between ex-post and ex-ante policies

Before we proceed discussing the use of ex-post and ex-ante policies it should be noted that the liability rules discussed above are treated as ex-ante measures by some scholars and as ex-post measures by others. In legal literature the compensatory function of the strict liability rule is viewed as more important due to its distributional advantage (Posner 1977, p. 18, Wetterstein 2004, p. 66). Lawyers are concerned with the issues of justice. They address

primarily such questions as who should bear the cost of accidents. Nevertheless, one cannot but admit that lawyers and judges are also concerned with the preventive dimension since any decision constitutes a precedent. Legal errors can encourage unlawful behaviour in the future.

In economic literature there is no unanimity on how the strict liability rule should be classified. Some economists (Faure 1995, Faure and Hui 2005) state that the prime goal of liability law is to ensure deterrence in order to prevent future accidents and thus reduce accident costs. Other authors (Kolstad et al. 1990, Schmitz 2000) support the legal approach and treat liability as an ex-post measure. One reason can be that in case of environmental pollution, which is studied by Kolstad et al. and Schmitz, liability fails sometimes to provide deterrence, for example, due to uncertainty about causation.

Economists have generally treated the ex-ante and ex-post instruments as substitutes. One of the most noticeable features of current policy correcting for externalities is the combined use of ex-ante and ex-post techniques. The most cited example is from the USA. There are ex-ante technological regulations (The Resource Conservation and Recovery Act 1982) as well as ex-post codifications of liability (The Comprehensive Environmental Resource, Compensation, and Liability Act 1979) governing the generation and disposal of hazardous wastes. We will first provide the analysis of strict liability and safety standards treating them as substitutes and then study the efficiency of their joint use.

2.3.2.1. *Substitutionary use of liability and direct regulation*

The economic literature studying various law enforcement strategies (Shavell 1984a, Glaeser and Shleifer 2003, Glaeser et al. 2001) suggests the following factors that may explain the social desirability of each single strategy:

- Knowledge about risky activities. If private parties are better informed about the benefits of their activity or the cost of reducing the probability and magnitude of risks than a regulatory authority, it would be sensible to let the private actors decide how to control the accident risk. In this case liability rules are preferred to regulation. Given the courts are able to acquire sufficient information to set the due care standard, negligence rule can also be efficient. There are also situations when the regulator possesses superior information about risks because to get such information requires substantial resources which private firms might lack.

- Incentives to enforce legal rules. Regulators may have strong economic incentives to pursue investigations, unlike judges. This argument favours direct regulation when a litigation process is costly and judges lack resources and incentives to engage in it. Such strong incentives are provided when a regulator is rewarded for finding violations or when he is better specialized to establish whether a violation has occurred. It appears to be that it is easier to incentivize regulators than judges because judges are more independent[16].
- Private parties' wealth restrictions. In this case regulation is more advantageous than liability. Under regulation, parties would be induced to take preventive measures to reduce risks as a precondition for engaging in their activities.
- Possibility of private parties to escape from suit. There are several reasons why tortfeasors may not be held liable. If the harms generated by the polluter are widely dispersed and there are many identical actors equally injured by the harm, it becomes unattractive for any single victim to bring a suit. It resembles a free rider problem in the sense that the cost of initiating legal action against the polluter is huge and is borne only by the "active" victim[17]. The benefit of penalizing the polluter in case the victim wins is shared by all the other injured parties (for example, the court obliges the polluter to clean up or to compensate the other victims). Another reason is the passage of a long period of time before harm is discovered. In this situation acquiring necessary evidence can be problematic.
- The administrative cost when either tort law or regulation is used. It is reasonable to believe that administrative cost under liability is lower than under regulation because the cost is incurred only if harm occurs (Shavell, 1984a). It is assumed further that even if harm occurs, administrative costs will still be low. First, under negligence, potential injurers are provided with incentives to exercise due care. Injured parties should be aware of it and should not sue the injurers. Second, it is likely that the cost of settlement of a suit is lower that the cost of a trial. However, Glaeser and Shleifer (2003) argue that the identification of violations may be cheaper and more certain under regulation. In some cases it is less costly to check if required safety equipment has been installed than to prove the injurer's negligence.

The analysis of these five determinants demonstrates that some of them may favour liability (administrative cost and informational advantage) and the other three favour regulation (enforcement incentives, wealth constraint and probability of escape from suit). It implies that

[16] Glaeser et al. (2001)
[17] This is not the case when the victim's claim is covered by the compensation fund financed by oil producers.

the exclusive use of either regulation or liability is not optimal. Their combination can provide a better solution to the problem of risk reduction.

2.3.2.2. *Complementary use of liability and direct regulation*

We discuss the efficiency of the joint use of liability and direct regulation based on the insights from Glaeser and Shleifer (2001), Shavell (1984b), Kolstad et al. (1990) and Schmitz (2000). The main argument for the joint use is that neither policy used alone incentivizes firms to choose the efficient level of care.

Glaeser and Shleifer (2003) suggest that the optimal choice of enforcement regimes, in particular, direct regulation and/or litigation, depends crucially on their vulnerability to subversion[18]. Vulnerability to subversion hinges, in its turn, on how much law and order a country has. A combination of regulation and litigation is efficient when the level of law and order is intermediate. Normally, the penalties associated with a pure liability regime are high, and justice is subject to subversion in this regime. Since in some cases regulation provides a cheaper verification of violations and, consequently, imposes lower fines (see the administrative cost criterion in the previous subsection), it is subverted less frequently. Therefore, regulation supplementing liability may become advantageous.

The main criticism of exclusive use of direct regulation is that the regulator has imperfect information about damage, h[19]. Thus, inefficiency arises because pure ex-ante regulation requires the same regulatory standard for all injurers. Firms that cause small accidents are over-regulated and firms that cause large accidents are under-regulated.

Let s be a regulatory standard of care, $s \in [0, 1]$. The socially optimal standard s_R can be found by minimizing the expected total cost:

$$\min_s E[C(s) + (1-s)h] \quad (12)$$

FOC: $$C'(s_R) = E[h] \quad (13)$$

The optimal standard s_R is given by $s_R = x^*(E[h])$.

[18] By subversion the authors mean a number of legal (favourable legislation) and illegal (bribing judges) strategies aiming to avoid punishment.

[19] We use the same setup as in 2.2.5, but now we assume that there are several injurers and victims. It is also assumed that h can be verified once an accident has occurred.

For any given h the regulator will prefer the approach that gets the society closest to x^*. Shavell (1984b) argues that a mixed regulatory system can sometimes do better than either approach alone. Direct regulation effectively provides a lower bound on precaution and should be used for low levels of harm. For larger accidents, liability will apply. The optimal combination of direct regulation and liability is shown in **figure 6**, p. 54, as $x_{RL}\ (h)$. Liability used alone ensures level of care x_L that is below the first best amount, $x^*(h)$, for all values of h. Besides x_L is constant in its argument for high levels of harm $h \geq \hat{y}$. Under regulation, s_R is too high for small accidents and too small for large ones. Since under the joint use of regulation and liability, regulation is preferred for smaller accidents, the standard s_{RL} should be set lower than s_R. In some cases when the standard is set too high, in **figure 6** $\hat{s}_{RL}$, a combination of the two measures does no better than regulation alone. Use of liability is superfluous as the outcome is the same as if regulation alone was employed.

Kolstad, Ulen and Johnson (1990) analyse a combination of negligence liability and safety standards. They base their model on the assumption of a potential injurer's uncertainty about the legal standard. It is shown that this uncertainty makes the negligence standard inefficient. In some cases when polluters underestimate the legal standard of care and take insufficient precaution the complementary use of direct regulation can correct the inefficiency. Otherwise, imposition of ex-ante regulation, given negligence, will exacerbate the existing inefficiency, because firms invest too much already at the outset. However, it is not clearly explained why negligence standard should be used at all because safety standard can always implement socially optimal behaviour.

In Schmitz (2000) the assumption of the Shavell model (1984b) about enforcement errors and non-verifiability of firm profits is abandoned. Schmitz (ibid, p. 372) argues that:"while it is certainly true that courts make mistakes, it seems to be unsatisfactory to base a theory on the assumption that the same kind of error persistently occurs". Assuming that $0<q\leq 1$ has an important implication for calculating the size of the optimal magnitude of liability, L^*. In the Schmitz model the expression for the total cost under liability is slightly changed. Now liability L appears instead of the magnitude of harm h in expression (10), p. 12 so that $x_L=x^*(q \bullet min\ \{L,y\})$. Schmitz proves that liability used alone can implement the first-best solution if the injurer's wealth is sufficiently large, or $L<y$. The optimal liability L^* is given by:

$$h= q \bullet min\ \{L,y\}=q \bullet L \quad \text{when } L<y$$

$$L^* = \frac{1}{q}h \quad \text{where } \frac{1}{q} \text{ is the punitive multiplier.} \tag{14}$$

Now L^* can be larger than h for all $q<1$. This outcome contradicts the result in Shavell (1984b). The reason is that the Shavell model holds only when L equals h which makes the magnitude of liability L strictly less than the optimal amount L^* for all $q<1$[20]. That can explain why Shavell states that liability accompanied by direct regulation can perform better than liability alone, given the same wealth.

Schmitz shows that if the regulator can observe firm profits and can moreover impose punitive measures, then either regulation or strict liability always dominates a combination of the two, given the same wealth constraint for all the firms. We provide a formal analysis of this result based on Schmitz (2000). The case where injurers are constrained is of interest (since with $y>\frac{h}{q}$ for all values of $h\in[0,1]$, the first best outcome is always realized). The amount of precaution taken when $y\leq\frac{h}{q}$ depends on the level of harm h:

$$x_L = \begin{cases} x^*(qy), h > qy \\ x^*(h), h \leq qy \end{cases}$$

The total cost under the sole use of liability is:

$$TC_L(y) = \int_0^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h) + \int_{qy}^{1} (C(x^*(qy)) + (1 - x^*(qy))h)dF(h) \tag{15}$$

Then we analyze the size of the regulatory standard that can complement liability:

- $s=0$ is identical to pure liability regime, hence s must be greater than 0,
- $s>x^*(qy)$ is equivalent to exclusive use of regulation, as liability never induces to take more care than $x^*(qy)$,
- only $s<x^*(qy)$ makes the joint use of both schemes reasonable.

The total cost under the joint use when $s<x^*(qy)$ is:

$$TC_J(s,y) = \int_0^{C'(s)} (C(s) + (1-s)h)dF(h) + \int_{C'(s)}^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h) + \\ + \int_{qy}^{1} (C(x^*(qy)) + (1 - x^*(qy))h)dF(h) \tag{16}$$

[20] If a possibility of bankruptcy is eliminated and suit is always brought the exclusive use of liability is efficient, according to Shavell's model (1984b).

It is proved in Appendix (section 2a) that $TC_J(s,y) > TC_L(y)$.

Since $TC_L(y)$ is a decreasing function of y ($\frac{dTC_L(y)}{dy} < 0$), there are values of y less than the threshold value $\hat{y}$ so that $TC_L(y < \hat{y}) > TC_R(s_R)$, for which regulation dominates liability. For other values of y such that $\hat{y} < y < \frac{h}{q}$ the liability regime is more attractive than regulation: $TC_L(y < \frac{h}{q}) < TC_R(s_R)$. Given that all injurers are homogeneous, all of them prefer either regulation or liability depending on their income y. Joint use of liability and regulation with $0 < s \leq x^*(qy)$ is not optimal. The case when $0 < s \leq x^*(qy)$ and $\hat{y} < y < \frac{h}{q}$ is also demonstrated in **figure 7**, p. 55, where the total cost under joint use is presented by the hatched area and the total cost under liability is the yellow painted area. Here q=1, the liability standard implements the first-best solution as long as the level of harm is below the injurer's assets.

It is also proved in Schmitz (ibid) that the hybrid can still promote efficiency under the assumption of individuals' heterogeneity with respect to wealth limitations. Suppose there are two groups of individuals in the economy: with low-income y_{poor} and with high income y_{rich} such that $0 < y_{poor} < y_{rich} < \frac{h}{q}$. Depending on the proportion of low-income individuals, $\pi \in$ [0, 1], regulation supplemented by liability is strictly preferred to exclusive regulation ($\pi > \hat{\pi}$) or to exclusive liability ($\pi < \hat{\pi}$). $\hat{\pi}$ is the threshold value that makes the regulator indifferent in the choice between regulation and liability[21]. The total cost under joint use of regulation and liability is

$\pi TC_R(s_R) + (1-\pi) TC_J(s, y_{rich})$.

Using the logics of the previous case when *all the individuals* are equally poor, their behaviour should be controlled by direct regulation. It is shown in Appendix (section 2b) that when *the majority of individuals* in the economy have low income, the complementary use of the two instruments increases social welfare because the total cost under regulation (15) exceeds the total cost under liability supplemented by regulation:
$TC_R(s_R) > \pi TC_R(s_R) + (1-\pi) TC_J(s_R, y_{rich})$.

[21] It is obtained from expression (17) in Appendix, section 2b.

One implication of the Schmitz model is that, given different income levels, the optimal regulatory standard s_R will depend on income y:

$$s_R(y) = \begin{cases} s_R > 0 \text{ if } y = y_{poor}. \\ s_R = 0 \text{ if } y = y_{rich}. \end{cases}$$

This means that it is not optimal to use the combination of the two policy instruments to control the incentives of one single individual or firm. Smaller firms will stick to the regulatory standard, while bigger ones will be regulated by a liability regime. The regulator setting s_R equal to zero for bigger firms can be criticized as being protective towards them. This implies that the regulator should explain the rationale for choosing a combination of these measures. Schmitz and Shavell find that regulatory standards should be more lenient when regulation and liability are used jointly. However, the reason for having lenient standards in these papers is to decrease the care exercised by some low-income individuals, and not to influence the expected penalty borne by them.

3. Empirical analysis of the legal regime in Norway

3.1. International conventions dealing with oil pollution prevention and oil spill response systems

Norway has successfully supported the development of international environmental law and the endorsement of many significant environmental policy declarations. The challenge to achieve sustainable development largely depends on Norway achieving its economic and environmental objectives through an effective combination of economic and regulatory policy instruments.

The maritime business in general has its own specific features that influence the marine environment legislation. Firstly, it is an international business. The sea knows no boundaries, and neither does pollution. Some pollution problems could not therefore be tackled effectively without joint action of countries at the international level. Secondly, the offshore nature of oil production and transportation may make it difficult to enforce legislation, for example, in cases when discharges of oil or other chemicals are not easily detected.

Like any other policies, international conventions regulating oil pollution can be also classified by their aim into ex-ante (prevention) and ex-post (compensation) measures. We will provide an overview of the international regime in so far as it is applicable in Norway.

3.1.1. Prevention and Safety Conventions mainly focus on the technical requirements such as ship structure standards and safety standards which should be enforced by the contracting States.

A. **The MARPOL Convention** 1973/1978[22] was adopted by the International Maritime Organization (IMO) and is the main international convention covering prevention of pollution of the marine environment by ships. Norway ratified it on 15 June 1980 and the convention entered into force on 2 October 1983. The convention was incorporated in Norwegian legislation under *MARPOL-forskriften*[23] and *Sjødyktighetsloven, chapter 11*[24]. Annex I contains the most important regulations for preventing pollution by oil from ships. According to the requirements in Annex I, oil-carrying ships are required to be capable of operating the method of retaining oily wastes on board through the "load on top" system. This involves the fitting of appropriate equipment, including an oil-discharge monitoring and control system, oily-water separating equipment and a filtering system, slop tanks, sludge tanks, piping and pumping arrangements. Secondly, new oil tankers are required to meet certain subdivision and damage stability requirements so that, in any loading conditions, they can survive after damage by collision or stranding.

Revised Annex I was introduced in the Norwegian law by *forskrift 15.09.1992 nr. 693* requiring oil tankers to keep an oil record book, in which is recorded the movement of cargo oil and its residues from loading to discharging on a tank-to-tank basis. *Forskrift 3.06.1993* incorporates the 1992 amendments to Annex I that made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls.

B. One more convention initiated by IMO is the **International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)**. It was ratified by Norway on 8 March 1994 and entered into force on 13 May 1995. Ships and operators of offshore units are required to carry oil pollution emergency plans or similar arrangements which must be co-ordinated with national systems for responding promptly and effectively to oil pollution

[22] International Convention for the Prevention of Pollution from Ships
[23] *Forskrift 16. juni 1983 nr.1122 om hindring av forurensning fra skip*.
[24] *Sjødyktighetsloven (LOV-1903-06-09 nr 7)* has been repealed , and a new law entered in force (*Skipssikkerhetsloven , LOV 2007-02-16 nr 09*)

incidents. Persons in charge of ships and offshore units are also required to report incidents of pollution to coastal authorities and the convention details the actions that are then to be taken. The convention calls for the establishment of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents by the Parties.

C. **The OSPAR Convention**[25] was ratified by Norway on 8 September 1995 and entered into force on 25 March 1998. Annex III deals with prevention and elimination of pollution from offshore sources, including oil pollution. The convention includes a series of provisions and, among other things,

- requires the application of:
    - the precautionary principle;
    - the polluter pays principle;
    - best available techniques (BAT) and best environmental practice (BEP), including clean technology;

- provides for the Commission established by the OSPAR Convention to adopt binding decisions;
- provides for the participation of observers, including non-governmental organisations, in the work of the Commission;
- establishes rights of access to information about the maritime area of the Convention.

In the Norwegian law the provisions of the OSPAR convention are reflected *in forskrift 1.06.2004 nr 931 om begrensning av forurensning (forurensningsforskriften) kapittel 19* and in *forskrift 3.09.2001 nr 1157 om utføring av aktiviteter i petroleumsvirksomheten (aktivitetsforskriften), kapittel X-II.*

An example of practical application of the OSPAR provisions is a requirement of certain clean-up techniques. *Forurensningsforskriften*[26] regulates the use of oil dispersants and other chemicals dissolving oil in case of accidental oil spills. All the chemicals should be initially

[25] Convention for the Protection of the Marine Environment of the North-East Atlantic. The convention merged and modernized the Oslo Convention signed in 1972 (Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft) and the Paris Convention (Convention for the Prevention of Marine Pollution from Land-Based Sources) signed in 1974.

[26] *Kapittel 19. Sammensetning og bruk av dispergeringsmidler og strandrensemidler for bekjempelse av oljeforurensning, §19-4, vedlegg 1.*

tested and the test results are to be reported according to the Harmonised Offshore Chemical Notification Format[27]. Another example refers to a particular method of measuring concentration of oil dissolved in water[28].

D. The International Convention for the **Safety of Life at Sea** (SOLAS) is the most important treaty dealing with maritime safety[29]. SOLAS was ratified by Norway on 17 February 1977[30] and entered into force on 25 May 1980. The 1974 Convention has been updated and amended on numerous occasions (1978, 1988)[31]. SOLAS specifies minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag states are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the convention as proof that this has been done[32].

E. **The 1966 Load Line Convention (ICLL)** came into force on 21 July 1968. Along with the International Convention on Safety of Life at Sea (SOLAS), it is the primary document setting forth internationally agreed ship safety standards based on contemporary developments in ship design. The regulations take into account the potential hazards present in different zones and different seasons. The main purpose of the safety measures imposed by the ICLL is to ensure the watertight integrity of ships' hulls below the freeboard deck. All assigned load lines must be marked amidships on each side of the ship, together with the deck line.

F. **The International Convention on Standards of Training, Certification and Watch-keeping for Seafarers (STCW)** was adopted in 1978 and entered into force in 1984. The Convention was significantly amended in 1995. **STCW** was the first to establish basic requirements on training, certification and watch-keeping for seafarers on an international level. Previously these standards were established by individual governments, usually without reference to practices in other countries.

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[27] The Harmonised Offshore Chemical Notification Format is defined in OSPAR Recommendation 2000/5, the latter is amended by OSPAR Recommendation 2005/3.

[28] OSPAR ref. nr. 2005-15, a modification of ISO 9377-2, *forskrift 3. september 2001 nr 1157 om utføring av aktiviteter i petroleumsvirksomheten,* §61.

[29] It is also one of the oldest conventions. The first version was adopted at a conference held in London in 1914 in response to the sinking of the RMS Titanic.

[30] *Ot.prp.nr.31 (2005-2006) om lov om endringar i lov 24. juni 1994 nr. 39 om sjøfarten (sjøloven)*

[31] The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.

[32] http://www.imo.org/Conventions

3.1.2 Compensation Conventions are meant to provide compensation schemes for the victims and give the potential polluters incentives to take the preventive measures to avoid pollution.

Two major international conventions addressing compensation for damage caused by oil spills from laden tankers are the 1969 **International Convention on Civil Liability for Oil Pollution** Damage (CLC) and the 1971 **International Convention on the Establishment of an International Fund for Compensation for Oil pollution Damage.** The CLC addresses the liability of ship owners for oil pollution damage in the territorial sea or exclusive economic zone of a Contracting Party from the discharge of oil carried in bulk. The Convention establishes the principle of strict liability for ship owners and creates a system of compulsory liability insurance.

The strict liability regime in the 1969 CLC represented a dramatic departure from traditional maritime law which based liability on fault. In order to relieve the ship-owner of the liability burden by the requirements of the 1969 CLC and at the same time to provide additional compensation to the victims of pollution damage in cases where compensation under the 1969 CLC was either inadequate or unobtainable, a special fund was established by the 1971 Fund Convention[33].

In 1992 both the 1969 CLC and the 1971 Fund Convention were replaced by their 1992 Protocols[34]. The 1992 Protocol also extended the Convention to cover spills from sea-going vessels constructed or adapted to carry oil in bulk as cargo so that it applies to both laden and unladen tankers, including spills of bunker oil from such ships. Under the 1992 Protocol, a ship-owner cannot limit liability if it is proved that pollution resulted from the ship-owner's personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result. Norway ratified both 1992 Protocols on 3 April 1995 and they came into force on 30 May 1996. The provisions of the 1992 Protocol to the CLC were introduced into Norwegian legislation in the Maritime Code

[33] International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage

[34] The 1969 CLC regime and the regime established in the 1992 Protocol are co-existing, since there are a number of States which are Party to the 1969 CLC and have not yet ratified the 1992 regime - which is intended to eventually replace the 1969 CLC.

24.06.1994, chapters 10 and 12. The 1992 Protocol to the Fund Convention[35] was included in the Maritime Code *24.06.1994, §201*[36].

There was a series of amendments to the 1992 Protocol to the Fund Convention, among which the most important ones took place in 2000 and 2003. In October 2000, following the Erika disaster in 1999, a 50.37% increase in the limit of liability under the 1992 Protocol, was agreed by the IMO. Norway adopted both the 2000 Amendment[37] and the 2003 Protocol establishing an International Oil Pollution Compensation Supplementary Fund (the Maritime Code*, §201)*[38] and further expanding the amount of compensation.

3.1.3 UNCLOS

The United Nations Convention of the Law of the Seas, **UNCLOS,** concluded in 1982, was ratified by Norway 24.06.1996[39] and entered into force 24.07.1996. UNCLOS is a global convention providing a jurisdictional framework that regulates the features and extent of State jurisdiction for the implementation of IMO conventions. UNCLOS governs all aspects of ocean space, among others environmental control, marine scientific research and the settlement of disputes relating to ocean matters. Some of the key features of the Convention relevant to prevention of marine pollution are the following:

- sovereign rights in a 200-nautical mile exclusive economic zone with respect to natural resources and certain economic activities;
- States bordering enclosed or semi-enclosed seas are expected to cooperate in managing living resources, environmental and research policies and activities;
- States are bound to prevent and control marine pollution and are liable for damage caused by violation of their international obligations to combat such pollution.

Table 2 summarizes the discussion of the impact of relevant international conventions on Norwegian legislation.

[35] Protocol to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage
[36] *Ot.prp.nr.21 (1994-1995)*
[37] *Ot.prp.nr.32 (2001-2002),* in force from November 2003
[38] *Ot.prp.nr.28 (2003-2004)*

[39] *St.prp.nr.37 (1995-1996)* and *Innst.S.nr.227 (1995-1996)*

Table 2. Implementation of International Conventions Regulating Oil Pollution in Norway			
	Compensation and Liability	Prevention and Safety	Jurisdiction
Transportation	CLC 1969, Fund 1971 Amendments 1992 to CLC 1969 and Fund 1971 Amendments to Fund 2000, 2003	MARPOL OSPAR OPRC SOLAS Load Lines STCW	UNCLOS
Production	Supplementary Fund 2003	OSPAR OPRC	

3.2. Critical economic analysis of the current liability regimes for marine oil pollution in Norway

In this section we are going to analyze existing oil spill-related legislation in Norway in light of the economic theory presented in Part 2. The main issue to address is whether the existing legal rules promote efficiency from the economic point of view.

3.2.1. *Nature of the liability rules*. First of all, it is of interest to compare the liability regimes in the oil production and oil shipping sectors. Oil pollution liability standards for offshore activities, such as exploration and exploitation of petroleum resources, are defined by the provisions of the Petroleum Act, chapter 7[40]. The act imposes strict liability on licensees. The Maritime Code (MC), chapter 10[41], sets out liability for cargo ships. The Code places strict liability for damage caused by oil spills from a ship or installation transporting oil as bulk cargo on owners of ships, drilling rigs and other mobile installations. To avoid confusion in interpreting the laws' scope of application it should be mentioned that there is a part of activities related to oil production which are however regulated by MC. If a spill of crude oil is caused by a ship involved in offshore facility activities under oil loading operation the liability of the polluter will be defined by the Petroleum Act. If the accident occurs under transportation of crude oil by the same ship the liability for pollution will be regulated by MC.

[40] *LOV-1996-11-29-72*
[41] *LOV-1994-06-24-39*

From an economic perspective, different interpretations of certain definitions in the laws can create inefficiency by altering the optimal precaution level. If a drilling rig owned by an oil company can be classified as a floating installation, the company is still held strictly liable, but now it can benefit from limitation of liability set by the Maritime Code, unlike in the situation when a rig is treated as an installation. Meanwhile, the way a particular facility is classified by the laws has no effect on risk. Regardless of whether a facility is treated as a ship or an installation, the risk associated with its employment remains the same. Thus, the liability for damage and the optimal care level should not differ.

The economic literature posits that the efficiency of each liability rule hinges on the nature of a particular accident. For example, people living in coastal areas have no influence on the probability of oil spills ex ante. An example of an "active" victim whose actions affect the magnitude of losses after an oil spill is coastal authorities. They can take preventive measures in order to reduce the coastal zones' exposure to marine oil pollution. Nevertheless, potential polluters' (tank ship's owner or licensee) effect on the accident risk seems to be more important. It should be stressed that it is difficult to classify oil spill accidents as purely bilateral because the impact of the authorities' actions on the probability of oil spills can be smaller in comparison with the polluters' influence. Strict liability of the injurer imposed by the Petroleum Act*, §7-3* and the Maritime Code*, §191* is economically reasonable in unilateral and not purely bilateral cases.

There are also provisions in both laws for the liability for purely bilateral cases when victims' actions are quite significant for reduction of oil spill risk. By the Maritime Code*, §192,*

Godtgjør eieren at skadelidte forsettlig eller uaktsomt har medvirket til skaden, kan ansvaret lempes etter alminnelige erstatningsregler.

According to the Petroleum Act*, §7-5,* if the owner proves that the pollution damage resulted either from a personal act or from negligence of the person who suffered the damage, the owner may make a claim for compensation for pollution damage against this person.

In both laws potential victims' contribution to the accident risk is taken into account. Thus, under some circumstances the owner can be wholly or partially exonerated from his liability to the injured party if the latter has wilfully or negligently contributed to the damage. An economic argument in favour of strict liability with a defence of comparative or contributory

negligence is that the authorities are more concerned with control of the polluters' activity which creates a preference for strict liability, and not negligence. Since victims' activity is less important its regulation is not the main target of the rule. It is sufficient to induce victims who influence the accident risk to take optimal care which is done by adding contributory or comparative negligence. Hence the choice of the strict liability with a defence of negligence is in unison with economic theory.

The analysis can be applied in a market setting when parties enter in a contractual agreement, for instance, a cargo-owner (customer) and a ship-owner (lender of a tank ship). In this case a tank ship is a durable good[42]. Cargo owners can take precaution by choosing safer tank ships. Ship owners in their turn can also exercise more care by acquiring safer and more expensive oil carriers. In order for a cargo-owner to efficiently decide on how frequently to lease out tank ships he should bear his own accident losses. That is achieved under the negligence rule provided the cargo owner is perfectly informed about risks (for example, the age and technical characteristics of leased tank ships). When risks are misperceived by the cargo owner, putting strict liability on the ship-owner with a defence of contributory negligence does not promote efficiency because the cargo owner has no motive to limit both his activity and the frequency of leasing out ships. While the ship owner is always held strictly liable, no liability is imposed on the cargo owner unless he is liable for the accident by *§193, item c* (ibid):

Erstatningskrav for forurensningsskade kan ikke gjøres gjeldende mot: c) rederen eller disponenten hvor disse ikke eier skipet, samt enhver befrakter, sender, avlaster, eier eller mottaker av lasten, unntatt hvis vedkommende selv har voldt skaden forsettlig eller grovt uaktsomt og med forståelse av at slik skade sannsynligvis ville oppstå.

Assuming that cargo owners can get complete information about a particular tank ship from the leasing company, we observe that provisions in MC deviate from the outcome in economic literature supporting negligence. A possible economic explanation for this is that the ship owner's effort to prevent accidents may have a greater risk- reducing effect than the cargo owner's preventive actions. Legal literature highlights the rationality of strict liability of the ship-owner because one can avoid uncertainty caused by other parties' exposure to liability. Besides, there is no need for other parties to purchase insurance they would otherwise be required to have approved (Falkanger et al. 2004, p. 203).

[42] The risk of accidents using durable goods is affected not only by the level of care which holds for non-durable goods, but also by frequency of use of such goods (Shavell 1980, p. 8).

3.2.2. *Limitation of liability*. The Petroleum Act and the Maritime Code have different provisions concerning the limits of liability. In case of damage caused by an oil spill under oil transportation the carrier's liability is limited to a certain amount, by MC*, §194*[43]. However, the Petroleum Act warrants no limitation on liability of the licensee, with the exception of accidents caused by force majeure. It has been mentioned above that the conventions handling oil pollution liability are reactive in the sense that they are successfully amended after each new incident shows that the previously agreed limits were insufficient to meet greater oil spills. The constant changing nature of the compensation limits raises the question of whether there should be a limitation of liability at all.

The standard economic literature approves of the use of strict liability only when assuming the polluter's full solvency. Strict liability supplemented by financial caps is equivalent to strict liability under insolvency. Limitation of liability performs better in presence of negligence rule which is not featured in the current legislation.

In light of this result, the Petroleum Act provides more incentives to the actors to invest in preventive measures than the Maritime Code. Besides, limitation of liability in the maritime industry contradicts to implementation of the polluter pays principle formulated in the OSPAR convention by which the polluter should be fully exposed to the damage.

There are some possible reasons that can justify financial caps for ship owners:

- limitation of liability of the carriers has been traditional in maritime law;
- the risk associated with offshore oil production activities is much higher than the risk under oil transportation; the probability of accidents in the petroleum industry is also higher. The scope of activities under petroleum extraction and exploitation is wider, and practically all the stages of oil production involve risk of accidents. It seems more important to control under- deterrence in the oil production sector than in the oil shipping sector;
- offshore oil facilities operate on a larger scale than oil carriers, and the probability of facing wealth constraint is lower in the petroleum industry;
- supposing unlimited liability were placed on ship-owners as well, it would be easier for them to circumvent it. The problem can be solved by reducing the number of assets (establishing a single-asset company) or organizing insolvency,

[43] The limit of liability for ships under 5000 gt is 4.510.000 SDR. For skips over 5000 gt the liability increases by 631 SDR pr. ton over 5000 tons. The maximum limit is capped at 89.770.000 SDR.

- financial caps in bilateral accidents motivate victims to reduce the accident risk being the second means to control victims' behaviour (together with a defence of contributory negligence).

It should be remembered that efficiency can be achieved in the presence of financial caps when the conditions of the Coase theorem are met. Given complete information, the parties can specify in an agreement how the accident risk will be shared and under what circumstances the liability may be limited and to what extent.

3.2.3. *Compulsory insurance.* It has been mentioned above that strict liability is efficient when potential injurers are solvent and their liability is unlimited. Otherwise, one is confronted with a problem of underdeterrence and underinsurance. The injurer will be willing to purchase an insurance coverage up to the amount of his own assets. One way to circumvent underinsurance is to demand compulsory insurance covering the value of the expected losses. One can argue that in this case full liability is transferred to the insurer. Nevertheless, if the insurer is able to control the behaviour of the insured, for example, by charging higher risk premiums, the compulsory insurance mechanism is more effective in achieving cost internalization than the strict liability rule not protected by insurance. It should be noted that it is sometimes challenging to cope with the moral hazard problem. An example is a P&I insurance. P&I clubs are organized as mutuals and they provide collective self insurance to its members. The fact that risks are not shifted to the third party but are shared among all the members can reduce the insurers' incentives to monitor the behaviour of the insured. Besides, P&I clubs are criticized for their market power: their share in the global marine insurance market is 89%[44]. This may lead to a lower supply of insurance against oil pollution damage because of high variability of volumes of oil that might be spilled.

The Maritime Code*, §197* stipulates that ships carrying over 2000 tons oil in bulk as cargo are required to maintain insurance or other financial security to cover the liability of the registered owner for pollution damage in an amount equal to the limits of liability set by MC*, §194.* Such high limits as specified in footnote 42 are sure to motivate insurance companies to control the behaviour of the insured and see to it that the insured exercises due care to avoid accident risk.

[44] Faure and Hui (2005)

An issue that arouses criticism concerns exclusion of ships transporting less than 2000 tons of oil. Assuming smaller tankers can be potentially insolvent, the absence of financial security will create insufficient incentives for owners of such tankers to take care. On the other hand, exclusion of such tankers allows saving administrative costs.

3.2.4. *Exclusion from liability*. Both laws[45] relieve the actor (ship-owner or licensee) of liability for compensation in case of an act of war or force majeure.

Force majeure can be defined as follows[46]: "…what the underwriters called, in French a 'cas de force majeure' and in English an 'act of God', i.e. a natural phenomenon of an absolutely exceptional kind such as could not be avoided and on so large a scale that no preventive measure could be taken, as when a vessel was caught by an earthquake or hit by a meteorite". Typically, force majeure clauses cover natural disasters, war, crimes, strikes, acts of God, governmental restrictions, power failures, damage or destruction of any network facilities or the failure of third parties, such as suppliers and subcontractors, to perform their obligations to the contracting party. Force majeure provisions excuse a party from liability if some unforeseen event beyond the control of that party prevents it from performing its obligations under the contract. A party is exonerated from liability only if the failure to perform could not be avoided by the exercise of due care by that party.

Inclusion of force majeure clauses is highly relevant for the offshore sector activities. Both fixed and mobile offshore facilities operate in weather events ranging from hurricanes to winter cold and summer heat. Besides the damage from accidental oil spills caused by force majeure is more complicated to bring under control offshore than onshore.

It is sensible from an economic point of view to exonerate the actor from liability under force majeure. Typically, a threat of liability induces a party to exercise care to reduce the probability of acute oil spills in the sea. Imposing liability for oil spill damage that occurs due to, say severe weather conditions, has no point because the party's prevention effort can by no means influence changes in atmospheric pressure which cause storms. Hence, the care level taken by an actor does not eliminate the risk of force majeure events. Force majeure clauses protect incumbent firms from completely unnecessary investments in precaution, on the one hand, and motivate potential oil carriers or licensees to enter into the industry, on the other

[45] The Petroleum Act*, §7-3* and the Maritime Code*, §192*
[46] Official Records of the Conference on the Establishment of an International Compensation Fund for Oil Pollution Damage, 1971 (1978), p. 348

hand. The absence of such provisions would make potential entrants responsible for unreasonably high compensations so that they would rather choose to engage in other activities.

3.2.5. *Channelling of liability*. Channelling of liability to the ship owner or licensee is a feature of both laws[47]. The provision is one more object of criticism by economists. First, it should be remembered that channelling liability is not problematic when Coasian bargaining is feasible. It can be made explicit in a contract between the parties provided transaction costs are relatively low. For example, given a contractual agreement, a ship owner facing an increase in liability will be able to pass it on to a charterer in form of higher transportation cost. The charterer will be motivated to exercise more care by choosing safer ships and, in his turn, will transfer a part of the cost increase to a cargo owner. That will bring about an increase in oil prices that the public must in the end pay. One barrier to implementation of the Coase theorem is a costly negotiation process between the parties.

The adoption of the channelling provision in the 1969 CLC was influenced by the nuclear legislation in the 1960s that directed all the liability to the operator of a nuclear installation. In the 1992 CLC the list of persons excluded from liability was modified. The list included also the pilot, the charterer, operator or manager of the ship, the person performing salvage operations and any person taking preventive measures. There is an ongoing discussion about the adequacy of the channelling liability[48]. It is argued that one should go back to the 1969 CLC provision exonerating from liability only the servants and agents of the ship owner.

Economic literature admits the controversial nature of channelling liability. We will provide an economic analysis of the efficiency of channelling liability in the ex-ante and ex-post perspectives.

1) *Ex-ante perspective:* Channelling can be efficient because it may induce the optimal level of prevention. It allows avoiding excessive investment in precaution by several parties. Alternatively, when liability rests on several parties which are all exposed to the same risk, all of them take precautions. Their uncoordinated effort results in a too high overall cost and an unnecessarily high level of prevention.

[47] The Petroleum Act*, §7-4* and the Maritime Code*, §193*
[48] Faure and Hui (2003) and (2005), Fleischer (1983, pp. 431-437), Chao (1996, pp. 172-174), Wetterstein (2004, pp. 113-117)

The main disadvantage is that channelling discourages other parties who could have contributed to the prevention of oil pollution. Since they are totally excluded from liability, their incentives to take care are diluted. For example, the Maritime Code channels the liability to the registered owner (owners) of a tanker who may not engage actively in operating the tanker. A registered owner of a ship transfers often the control over operation of the ship to other parties (operators, charterers) or, in oil production, the licensee can commission an entrepreneur to perform drilling operations. It is primarily the entrepreneurs' preventive actions that reduce the probability of accidents. From an economic point of view[49] one would prefer a situation where all those who contributed in some way to risk would be exposed to liability.

Besides, channelling violates the polluter pays principle. In this case several and joint liability of the parties contributing to risk would dominate the liability channelled to the owner.

2) *Ex-post perspective*: The role of channelling is ambiguous with regard to the optimal compensation regime. On the one hand, there is no economically wasteful duplication of exposure to compensation claims. It is beneficiary for victims of pollution as they do not have to investigate who precisely is liable for damages. However, victims' benefit decreases because they can no longer claim damage from other liable parties[50].

Channelling is advantageous in the sense that it protects the ship owner's and the licensee's employees from liabilities that may exceed by far the employees' wealth. Similarly, making independent entrepreneurs partly liable together with the owner, given the owner's insolvency, could have had negative consequences for entrepreneurs' incentives to stay in the industry. Extending liability in this case would make small-size companies less enthusiastic about entering the market.

Channelling liability makes the compensation regime under the CLC and Fund Conventions inefficient from an economic perspective. If the victim cannot be fully compensated by the ship owner, the victim is paid by the Fund financed by cargo owners (oil companies). The tanker owner can be treated as an entrepreneur who is commissioned by the cargo owner to carry oil. According to the Maritime Code, cargo owners have no responsibility and the ship owner is held strictly liable. The only responsibility of cargo owners is his contribution to the

[49] This is a basic insight from standard externality theory (Førsund and Strøm 2000, p. 44, Perman et al. 2003, p. 134-136)
[50] However, victim's losses can be covered by insurance.

Fund. It is identical to the situation when in oil production all the liability would be placed on the entrepreneur while the licensee would be totally exempt from it[51].

To conclude the analysis, channelling seems to favour oil producers which dilutes the oil companies' incentives to take due care. The argument points to the need of reforming the current legislation. Negligence rule does not solve the channelling problem unlike in the case of disappearing defendant. This can only be achieved by extending strict liability to the parties responsible for the accident risk. An explanation to why the channelling provision is characteristic of the Petroleum Act and the Maritime Code can be that the Norwegian authorities are more concerned with the pragmatic appeal of the exclusivity of liability than with its negative effects.

3.2.6. *Strict liability and direct regulation.* In light of the analysis in subsection 2.3.2.1 oil production and oil transportation fall into the category of activities subject rather to regulation than liability law. The reason is that liability alone would not adequately reduce risk of pollution and the disadvantages of regulation are not as serious as in the liability law context.

As far as the cost of information is concerned, the authorities dealing with environmental risks have as a rule better access to relevant ecological knowledge. Small private companies, for example oil carriers, might lack the resources to invest in research and investigate what tanker design would be optimal. Private parties' incentives are often diluted due to the free rider problem. Phasing out of single hull tankers and state inspections by port states are the examples of implementing direct regulation in the oil shipping sector.

With regard to insolvency, oil carriers and licensees may often have limited assets while the potential harm to the environment caused by oil spills can be disastrous. Besides it is sometimes complicated to bring a suit against an oil company because either there will be many victims who will find it difficult to coordinate or the damage will only affect the unowned resources (marine ecosystem). The fact that publicly imposed instruments dominate tort law does not preclude the use of liability. One reason to resort to liability is that the effectiveness of direct regulation can be weakened by insufficient enforcement. Besides, direct regulation used alone is criticized for being less concerned with cost- benefit analysis and being more politically tinged, as in the case of phase out of single-hull tankers. In this

[51] Fleischer (1983, p. 436)

connection it is appropriate to emphasize the merit of safety regulation based on formal safety assessments proposed by IMO and broadly used in the shipping industry. FSA involves a) identification of all potential risks before they lead to accidents and b) cost- benefit evaluation of risk management techniques.

The analysis of the international conventions and Norwegian environmental legislation supports the idea developed in subsection 2.3.2.2 about the optimality of complementary use of strict liability and direct regulation. Examples are international conventions on prevention incorporated in Norwegian law. Along with liability allocation, they contain technical requirements (BAT, BEP) and can be treated like direct regulation methods.

In the petroleum industry the licensee's activity is regulated by a combination of strict unlimited liability and impure direct regulation. Such regulation comes from vague formulations of safety standards studied by Logstein (2003). The regulator sets a goal (for example, an emission target) and is less precise about the ways of achieving it. Logstein discusses the reasons underlying such regulatory methods and argues that vague formulations work better for incentive creation. Producers facing a goal are free to choose any technology. Assuming their rationality, they will choose the most cost- effective technology given the emission target. Therefore, vague formulations of technological standards render an incentive-based element to direct regulation.

3.3. Some important principles of environmental law in light of economic theory

We present an economic analysis of the polluter pays principle, precautionary principle and best available technology because they have become the leitmotifs of national and international environmental law and policy instruments. They are used to interpret and focus the legal rules discussed above.

3.3.1 The Polluter Pays Principle

The essence of the principle is as follows: "If you make a mess, it is your duty to clean it up". The first major references to the PPP appeared in 1972 and 1974 in OECD recommendations[52]. The principle can be defined as the rule that requires the polluter to take responsibility for the external costs arising from his pollution (De Sadeleer 2005, p. 21).

[52] Recommendation on Guiding Principles Concerning International Economic Aspects of Environmental Policies, Doc. No. C(72)128, OECD 1972.
Recommendation on the Implementation of the Polluter-Pays Principle, Doc. No. C(74)223, OECD 1974.

Internalization is complete when the polluter takes responsibility for all the costs arising from pollution; it is incomplete when part of the cost is shifted to the community as a whole. In all cases, the principle involves intervention by the public authorities.

It should be mentioned that in environmental law, the polluter pays principle can both favour a curative approach which is concerned with repairing damage done to the natural environment as a result of pollution (ex-post) and a preventive approach making polluters internalize the cost of chronic pollution (ex-ante).

From an economic perspective, the polluter pays principle can be viewed as two-fold: it ensures efficiency (the optimal pollution level) and a fair distribution of costs when the offender should always pay for the harm (Førsund and Strøm 2000, p. 236). Being originally a purely economic rule, the polluter pays principle has gradually required legal interpretation which is rather obscure. The main loopholes of the PPP are:

- Ambiguity in definition of *"pollution"* and *"polluter"*. De Sadeleer (2005, pp. 38-40) differentiates between two different concepts of pollution. According to the first one, one faces pollution only when emissions of pollutants exceed a certain threshold determined by the regulator. By the second concept, pollution is seen as dependent on its environmental impact, regardless of whether it is lawful or unlawful. It is obvious from the definitions of pollution in the Petroleum Act and the Maritime Code that both laws are based on the second concept[53].

  In legal terminology a polluter is someone who directly or indirectly damages the environment or who creates conditions relating to such damage. The definition is too broad to be supportive in many situations, including sea oil transportation and offshore oil production.

- Vagueness with regard to *how the principle should be implemented*. The conventional implementation of the PPP in many countries is based on the use of an environmental tax which is determined proportionally to the amount of emissions of the polluting substances. The PPP can be also introduced through a command and control approach

[53] By the Maritime Code*, §191: "Skade ved forringelse av miljøet omfatter i tillegg til tapt fortjeneste likevel bare utgifter til rimelige tiltak for gjenoppretting som har vært eller vil bli foretatt"*. By the Petroleum Act*, §7-1 "med forurensningsskade menes skade eller tap som skyldes forurensning som følge av utstrømming eller utslipp av petroleum fra en innretning, herunder brønn, og utgifter til rimelige tiltak for å avverge eller begrense slik skade eller slikt tap samt skade eller tap som slike tiltak medfører"*.

when the regulator specifies how a polluter should manage a pollution-generating process.

- Lack of precision concerning *how much the polluter should pay*. In the strict sense, the offender should cover the cost of prevention and control measures set by the regulator[54]. In the wide sense, the polluter has to take into account negative external effects of his activity that will persist in the future and will harm future generations[55].
- Exploitation of common pool resources. Access to these resources could be limited in some cases through assigning private property rights, however, this solution could lead to severe distributional conflicts.
- The PPP's vagueness in relation to *civil liability*.

It is of interest to discuss to what extent economic considerations can contribute to seal the indicated loopholes.

- With regard to the two concepts of *pollution* the impact-based concept seems more acceptable. The threshold- based concept provides no incentives to the polluters to reduce the amount of pollution once the standards are met. It makes the principle devoid of the preventive dimension. Besides, the threshold-based concept ignores the distributional aspect placing the burden of clean-up on the society in cases when emissions are lawful. However, the impact-based concept can also be inefficient. By economic reasoning, the polluter does not always need to clean up. Depending on the type of emissions and the emission load to which the relevant environmental media are exposed, some amount of pollution can be absorbed by the environment due to its assimilative capacity[56]. By the definitions in Førsund and Strøm (2000, p. 32) and in Pearce and Turner (1990, p. 62), emissions that do not reduce the quality of the natural environment are not considered pollutants in the economic sense. Moreover, economists argue that if "economic" pollution exists, it should not necessarily be eliminated. Some pollution can be beneficial. For example, zero pollution is inefficient in cases when production in non-polluting ways entails large additional expenses.

Identifying the *polluter* can be complicated because there may be several parties that contribute to pollution. The efficiency argument requires that the person to charge is the one

[54] This corresponds to the Standard interpretation of the PPP in Recommendation on Guiding Principles Concerning International Economic Aspects of Environmental Policies. Doc. No. C (72)128, OECD 1972
[55] This meaning of the PPP can be compared to the Extended interpretation of the PPP in Recommendation on the Implementation of the Polluter-Pays Principle, Doc. No. C (74)223, OECD 1974, but the Extended PPP does not make such additional compensations to victims obligatory.
[56] It is not typical of long-lived pollutants that accumulate over time.

who is best placed to pay. De Sadeleer (2002, p. 45) stresses that "it is far more efficient to go as far upstream as possible, by identifying the economic agent without whose action the nuisance could not have occurred". Following the reasoning in case of oil spills under oil shipping, it should be the producer of a tanker (and not the owner of the tanker on whom the Maritime Code places strict liability) whose contribution to reduction of accident risk is the most effective.

The problem of multiple economic agents who contribute to pollution is easier to solve, given civil liability. It was shown in subsections 3.2.1 and 3.2.2 that in some cases contributory negligence and financial caps make other liable parties bear the cost. However, the weakness of the polluter pays principle is more tangible under strict liability and taxation. For reasons of economic efficiency and administrative simplicity, it is preferable that only one liable party is charged a tax or held liable, but the principle does not indicate clearly how the regulator should determine the responsible party.

- From an economic point of view, the *choice of instrument* to carry out the PPP should be determined by the nature of an accident resulting in pollution. In unilateral cases the polluter can internalize the cost of damage in form of a Pigouvian tax given the tax is set at the optimal level. It can be equally economically efficient to subsidize the polluter for reduction in his activity and emission level. The polluter pays principle can be interpreted as restrictive. An exclusive use of the principle testifies to the regulator's rigidity in his approach to environmental management. Subsidies are generally more attractive to firms than monetary transfers to the state in form of taxes.

In bilateral cases the Coasean bargaining can result in efficient outcomes if it is supported by the liability rules specifying the parties' property rights. There may be cases when the pollutee pays principle is more effective than the polluter pays principle. Given the polluter has the property right and the victim can avoid accidents at a lower cost than the polluter, it is the victim who should compensate the polluter[57]. As in the case of Pigouvian taxes, to achieve efficiency it is not necessary that the polluter should pay. It seems that the legal instruments are more likely to provide efficiency than the PPP in solving many environmental problems because they are more flexible which facilitates their practical application. Nonetheless, effectiveness of liability rules is limited. For example, under asymmetric information the

[57] We assume that transaction cost is negligible

victim can exaggerate the magnitude of harm and claim higher compensation. In such cases both the PPP and the legal instruments are dominated by direct regulation (Huber and Wirl 1998, Wirl and Huber 1999).

- The *amount of compensation* the polluter should pay raises the question of evaluating the losses. Sometimes they are even unquantifiable, and their evaluation is impossible. Even if quantifiable, it is hard to calculate the monetary value of environmental damage. These considerations limit the polluter pays principle's compensatory aspect rendering its preventive function more significant.

- While analysing the PPP one may wonder if the principle has an influence on the *evolution of civil liability*. One is tempted to deduce from the PPP that liability for damage exists even in the absence of fault. There is still more to it than meets the eye. Given the PPP is carried out, the strict liability regime is rather complementary than substitutionary to the PPP. In some cases, for example, under force majeure or when an oil spill is caused by a ship collision, the PPP and the strict liability regime provide different solutions. The reason is that the PPP, unlike civil liability, is neutral with regard to the forseeability of events and the role of the involved parties' intentions in each particular accident. Conversely, it is the legislators' task to decide whether full or partial liability should be imposed on the polluter. Hence, the PPP can be treated as a political principle and it does not replace the strict liability regime.

From a legal perspective, the polluter pays principle remains vague despite the simplicity of its message. Economic arguments suggest that it is not always rational to resort to the PPP, like in regulating marine oil pollution where most accidents that lead to oil spills are bilateral. Though the PPP is not supportive to the legal system in case of identifying the liable party or in dealing with insolvent polluters, it can provide improvements to civil liability. This presents one more proof of the effectiveness of the combined use of different regulatory schemes.

3.3.2 Precautionary Principle (PP)

The precautionary principle is the most notable anticipatory principle existing in national and international laws. In a nutshell, it states that prevention is better than cure. The principle comes into its own where the parties are risk averse, or where decisions have to be taken in the face of uncertainty over potentially serious environmental impacts or irreversible threats

of harm. Perman et al. (2003, p. 250) underline that the principle serves several objectives: "it tries to bring together efficiency, sustainability, ethical and ecological principles, into a bundle that can inform target setting".

The comparison of the precautionary principle with the above mentioned polluter-pays principle and the principle of prevention reveals the PP's essence. Unlike the PPP, the PP and the principle of prevention are not derived from economic theory. Consequently, the economic issues in the PP are not the main focus of attention. The difference between the PP and the prevention principle is in the risks they are intended to reduce[58]. The principle of prevention applies to "certain" risks for which it is possible to establish the causal link between the initial event and its adverse effects. Only the length of time before the risk occurs will be unpredictable. A typical example is global warming. By contrast, precaution is tied to the notion of scientific uncertainty. For "uncertain" risks, the cause-and-effect relationship is not clearly defined, but there is a "reasonable scientific plausibility" (note 263, de Sadeleer 2005) that the relationship exists.

In international and national legislation the precautionary principle is subject to various interpretations. We attempt to analyze whether economic reasoning can make the meaning of the PP clearer.

First of all, the principle lacks clarity with regard to its application. Taking into consideration a wide range of problems it can be applied to (marine pollution, genetically modified foods, cell phones etc) it becomes clear that a choice of regulatory schemes depends on the sector, the nature of risk and political needs. It is also obvious that no single measure is capable of implementing the principle. The regulator's decisions are governed by his economic and ecological interests which have to be traded off against each other.

Approaching the principle from an economic angle reveals the problem of defining the optimal amount of precaution or, alternatively, the optimal amount of acceptable risk. Using the expected utility theory framework, the economically efficient level of pollution and consequently, precaution, is the one that maximizes a polluter's expected utility. It can be shown that the individually optimal level of care does not correspond to the socially optimal care level. The outcome is also inefficient when the regulator bases his decision about the optimal care level on a cost-benefit analysis. The reason is the same: under uncertainty there

[58] De Sadeleer (2005, pp. 158-161), Gollier and Treich (2003)

are no rules for integrating risk. For instance, it is impossible to quantify long-term damages to coastal and marine habitats and ecosystems as a result of oil spills. Besides, there are values that are difficult to gauge using classical economic valuation, for example, the existence value of endangered marine species.

It is obvious that while choosing a policy the regulator should consider the problem in question not only from an economic perspective. Restricting our attention to marine oil pollution, the regulator's actions often depend on the importance attached to environmental and economic interests. If the authorities are concerned with the protection of the marine environment more than with efficient allocation of economic resources they will avoid risk at any price and react immediately. From an economic point of view, it can be inefficient. For example, future risks may be highly exaggerated and preventive measures will cost more than damages. The merit of immediate preventive actions is that they often yield more flexibility for the future, so that acting early has an option value. Postponing preventive measures can be reasonable as their effectiveness is increased if the authorities expect to learn more about the future. On the other hand, the regulators risk irreversible damage in the future. Their inaction can cost them more than an immediate strategy in a context of incomplete information[59].

In case of accidental oil spills the precautionary principle is obviously violated, because oil spills represent a clear case of uncertain events for which adequate precautions have not been taken. Well-known remedial measures, such as use of double-hulled vessels for oil transportation and use of BAT in the petroleum industry, reduce impacts in the face of uncertainty. The relation between civil liability and the precautionary principle implemented by the OSPAR Convention seems spurious at first glance. However, the ex-ante element of liability regimes makes them compatible with the PP. One can argue that the precautionary principle is relevant only under negligence and totally irrelevant under strict liability. The reason is that the PP is instrumental in interpreting fault and, consequently, the optimal care level[60]. Practical application of the PP makes it necessary to enlarge the standard of care. Under uncertainty, a person who fails to take preventive measures to avert both certain and uncertain risks is to be held liable. In reality, the PP is implemented by means of strict liability

[59] Gollier, Jullien and Treich (2000) demonstrate that there can be no such conflict when information is imperfect and the consumer is risk averse. Though the regulator delays preventive action, the prospect of receiving information about the probability of accidents leads to higher current prevention effort.
[60] We assume that fault is defined only with regard to the duty of care.

supplemented by contributory negligence imposed by the Petroleum Act and the Maritime Code[61].

A vivid example of application of the precautionary principle by the Norwegian regulatory authorities is the zero-discharge project started in 1998[62]. The project's goal is that all new oil fields on the Norwegian shelf will be developed with the aim of zero discharges of oil and chemicals with environmentally hazardous properties. This ambitious goal has been successfully realised with regard to chemicals: the discharge of chemical additives during the period 1997-2006 has been reduced from 4161 to 42 tonnes which presents a reduction of around 99 per cent[63]. A further reduction in the discharge of hazardous chemicals is expected in the years to come. However, the greatest remaining challenge is the discharge of dispersed oil and naturally occurring environmentally hazardous substances in produced water.

At first sight the idea of zero pollution appears to be absurd because, due to the laws of thermodynamics, zero pollution means zero economic activity. Nonetheless, it is not totally inconceivable. First, the marine environment has a positive assimilative capacity. Second, the possibility of abatement allows increasing production without having higher emissions. The core problem in implementing the zero pollution target remains the same as with the PP: how much precaution to take to maintain the balance between security and cost efficiency. Here is the opinion of E. Lystad and I. Nilsson of the Norwegian Pollution Control Authority[64]: "today[65] there is no cleansing technology that completely will eliminate the discharges of hazardous substances in produced water"; "a level of physical zero discharges might not be the optimal solution. This might be the case <…> if the costs are too high".

The zero discharge goal was evidently inspired by provisions in OSPAR. The same convention recommends the 30 mg/l limit for dispersed oil in produced water[66]. In this context it seems logical to ask what precautionary approach is more reasonable: to reduce oil concentration in produced water to zero over the long term or to maintain current standards of produced water. The approaches to risk assessment suggest strongly that the main risk factor from produced water discharges is the concentration rather than the total discharge volume of

[61] The Petroleum Act, *§§7-3, 7-5* and the Maritime Code, *§§191-192.*
[62] The background for the project is *St.meld.nr.58 (1996-97), St.meld.nr.24 (200-2001) St.meld.nr.12 (2001-2002)* and *St.meld.nr.25 (2002-2003)*
[63] OLF Miljørapprort 2006 and *St.meld.nr.26 (2006-2007)*
[64] Note 7 in: Ekins, P., Vanner, R. and Firebrace, J. (2007).
[65] The opinion was expressed in 2004.
[66] The average concentration of dispersed oil in the produced water discharged to sea was 16.9 mg/l in 2006, according to OLF Miljørapport 2006.

the hazardous chemicals in produced water[67]. Hence, the 30 mg/l limit for dispersed oil in produced water as recommended by OSPAR seems to be more sensible a precautionary scheme than removing all hazardous substances from produced water. One can rejoin that forthcoming advancements in technology are sure to create new opportunities and new economics so that previously unthinkable strategies become practical. It is likely that in the years to come, continuous technological improvements will contribute to reducing discharges from the petroleum activities.

3.3.2.1 Best Available Technology (BAT)

BAT represents a command and control measure and can be looked upon as related to the precautionary principle or the principle of prevention depending on the regulator's knowledge of risks. The aim of BAT is to stimulate the adoption of cleaner processes by imposing minimal technology requirements, thereby shifting the focus on pollution control away from end-of-pipe solutions. The principle of BAT is based on both economic and technological feasibility[68]. This involves assessments of potential polluters' financial viability, environmental capacities and technological options to carry out abatement. One can show that in some cases recourse to economic reasoning, in particular cost-benefit analysis, may block implementation of BAT:

- When benefits of using BAT are measured in terms of reduced probability of accidents while costs are measured in monetary terms, the accuracy of a cost- benefit analysis is questioned.
- If regulatory authorities have incomplete information about polluters' financial capacity the latter can claim insufficient assets and evade the requirement to use BAT.

We can interpret the two goals - zero discharge of oil and the 30 mg/l limit for dispersed oil in produced water- as two BATs, the first one aiming at maximal purification and the second one requiring only partial purification. Supposing that both techniques are technologically feasible, the zero discharge practice involves a high cost so that the scheme may be cost inefficient. In fact, it appears to be that technological considerations do not favour the complete purification either. The scientific evidence[69] states that there is no harm to the

[67] Ekins, Vanner and Firebrace (2007)
[68] Economic elements have gradually been acquiring greater significance which the adoption of BATNEEC (best available technology not entailing excessive cost) proves.
[69] Ekins et al. (2007)

marine environment from components of produced water unless their concentration exceeds the 30 mg/l limit set by OSPAR. Hence, the economic and environmental cost of reducing discharges to zero is not currently justified. However, this ambitious goal can become reasonable in the future when new information and new technologies emerge.

To conclude the discussion of the precautionary principle, there are two major perils associated with an extreme approach to precaution. One is that excessive precaution can disrupt technological innovation, and it is universally accepted that innovation plays a significant role in economic progress. The second peril is that the environment would be harmed as the energy of regulators and the regulated society would be diverted from known or plausible risks to speculative ones. In general, economic reasoning does rationalize the use of the precautionary principle in some cases, but to rely only on the economic approach seems to be a one-sided strategy. Standard cost-benefit analysis should be refined to take account of scientific uncertainty, in ways that balance the precautionary principle against the benefits of waiting to learn before the regulator acts. Analysis of a BAT policy as an interpretation of the PP clearly demonstrates that both economic and technological considerations matter. The reliability of a purely economic approach turns to be doubtful even in case of certain risks. As for the PP's vagueness, it appears to be beneficial in the sense that it makes the principle's scope of application wider. Being primarily a legal principle, the PP conforms to the legal standards by which any principle should rather be "a flexible norm able to adapt to the heterogeneous situations in which it will be used" (De Sadeleer 2005, pp. 173-174).

4. Summary

This paper is an attempt to apply economic analysis to a particular area of law, namely environmental civil liability. Our aim was to demonstrate that economic theory has a positive role in studying the legal regimes. The rationale for economic analysis of law can be explained by the fact that the true grounds of legal rules are often inexplicit due to the rhetorical character of legal reasoning. Use of economic analysis can be regarded as a step aside from a traditional conceptual framework. The economic approach has a rich explanatory power because it is not based on a conceptual mode of thinking. One can argue that the legal and economic approaches may diverge, the former attaching more importance to justice and the latter valuing efficiency. However, these two notions are not mutually exclusive which testifies to the potential for further development of the law and economics field.

Marine oil pollution does not present a serious problem in Norway. One can affirm that the existing regulatory measures and legal regime are adequate in managing oil pollution. Nevertheless, the risk of oil spills persists. One should take into account the probabilistic nature of accidental situations and high variability of volumes of spilled oil that can change a situation dramatically.

In the theoretical part of this paper the standard model of law and economics was presented. It seems that theory provides no clear cut answer to what liability regime is most efficient. One cannot but doubt the realism of some of the model's assumptions, in particular, actors' risk neutrality. Market for marine insurance rather favours the assumption of risk aversion. In case of environmental pollution, and in particular marine oil pollution, theory states that strict liability is preferable to negligence because it provides the parties whose influence on risk reduction is more important with proper incentives to take precaution and limit the activity in order to eliminate the accident risk. Strict liability with a defence of contributory negligence is the legal regime imposed by current environmental legislation (the Maritime Code and the Petroleum Act). Hence, one can say that the model fits in well with reality.

Addressing the main question of the paper one can definitely say that Norwegian environmental legislation bears the stamp of economic reasoning. Such provisions as strict liability of ship-owners and licensees defended by contributory negligence, compulsory insurance in absence of moral hazard and exclusion of force majeure can be economically

justified. Sometimes the design of legal rules is not optimal from an economic perspective, for example, channelling liability to ship-owners or licensees of financial caps on liability.

Analysis of current policy instruments designed to manage the risk of oil pollution demonstrates the bite of theoretical models stressing the efficiency of combined use of several policy instruments. Pure regulation is sometimes difficult to enforce and it does not achieve cost efficiency. Liability alone is ineffective under polluters' insolvency and in case when punitive measures cannot be imposed on the offender. Coasean bargaining is not feasible due to high transaction cost and the fact that the sea water is a common resource. It is shown that ex-ante regulation and ex-post liability system do co-exist in reality.

The discussion of the basic environmental principles in section 3.3 shows that the legal rules analyzed in 3.2 are quite useful in interpreting the principles' provisions which lack precision. It is demonstrated that once the polluter pays principle or the precautionary principle are implemented legal rules do not become superfluous. On the contrary, they make the principles' provisions more concrete.

To sum it up, economic reasoning turns out to be a powerful tool in explaining legal rules and environmental principles though economic theory is not always supportive of these instruments. However, one should admit that in case of environmental pollution one is often more concerned with human health and safety issues and environmental interests. These are the areas where economic considerations are not sufficient.

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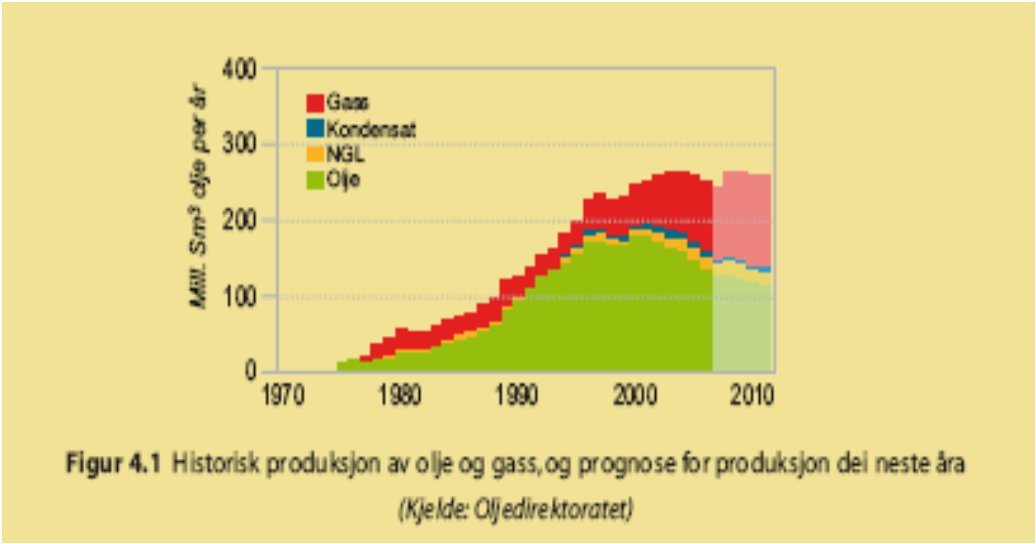
Figures

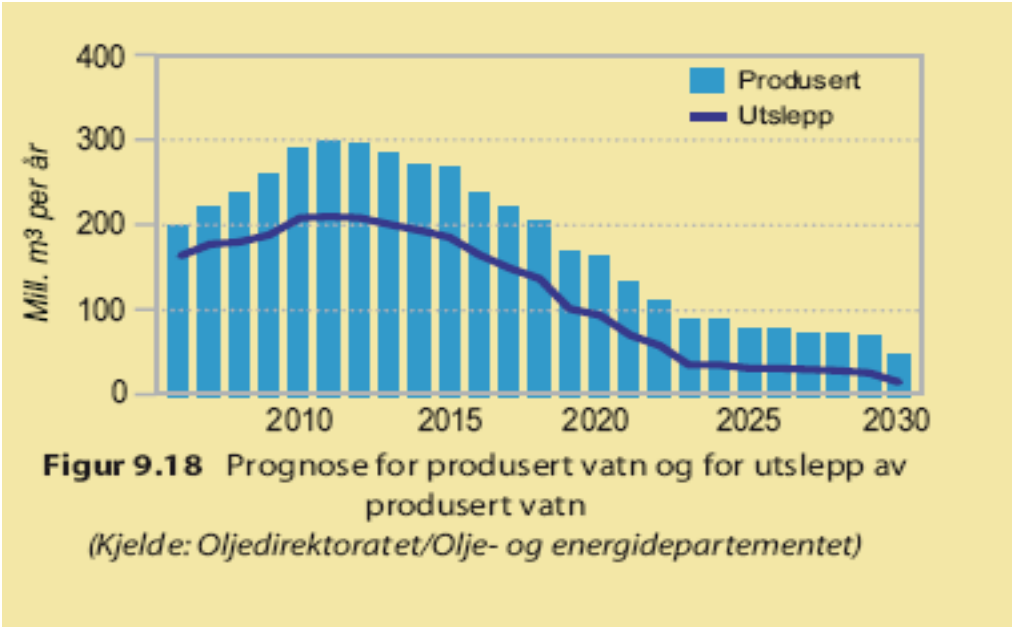
Figure 1. Oil and gas production on the Norwegian continental shelf 1970-2010



Figur 4.1 Historisk produksjon av olje og gass, og prognose for produksjon dei neste åra

(Kjelde: Oljedirektoratet)

Figure 2. Projected Production of Produced Water and Produced Water Discharges 2006-2030



Figur 9.18 Prognose for produsert vatn og for utslepp av produsert vatn

(Kjelde: Oljedirektoratet/Olje- og energidepartementet)

Figure 3. Number of Spills by Spill Source 1987-2006
Source: Kystverket

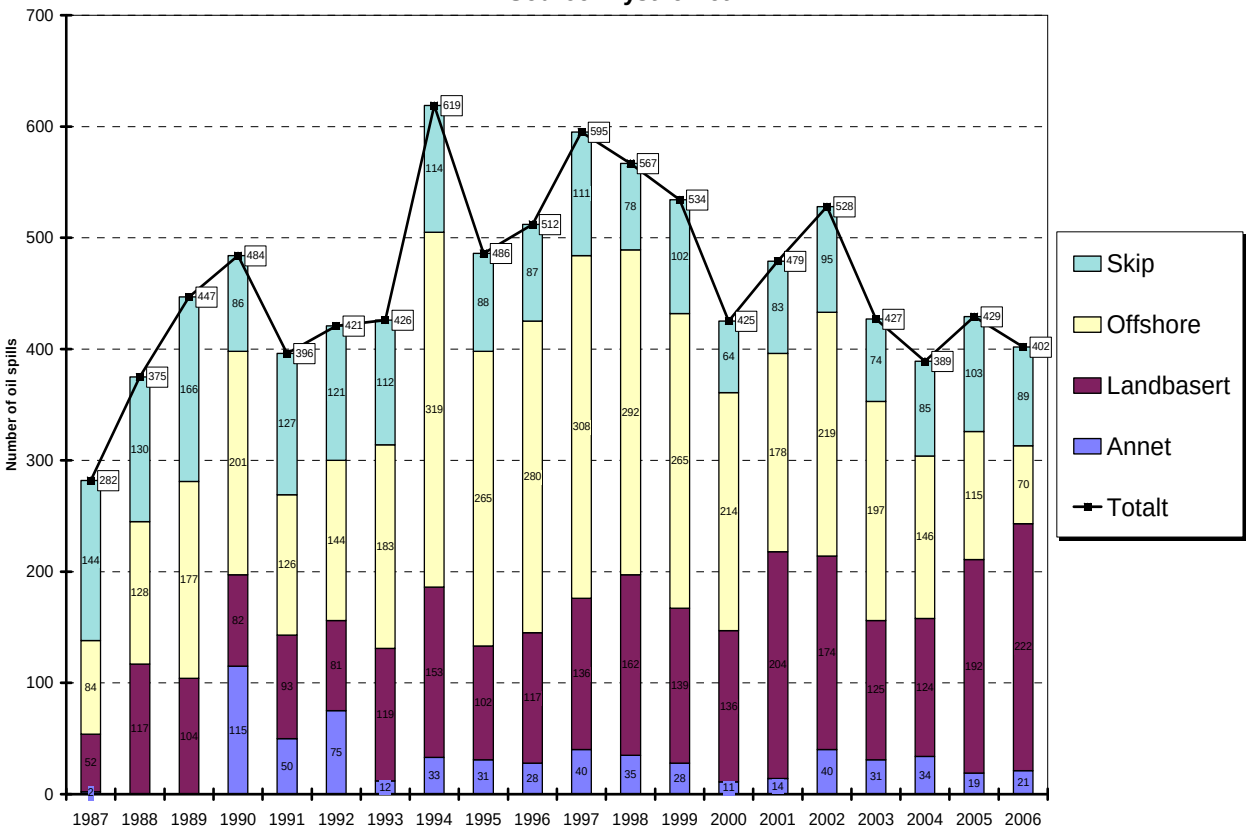
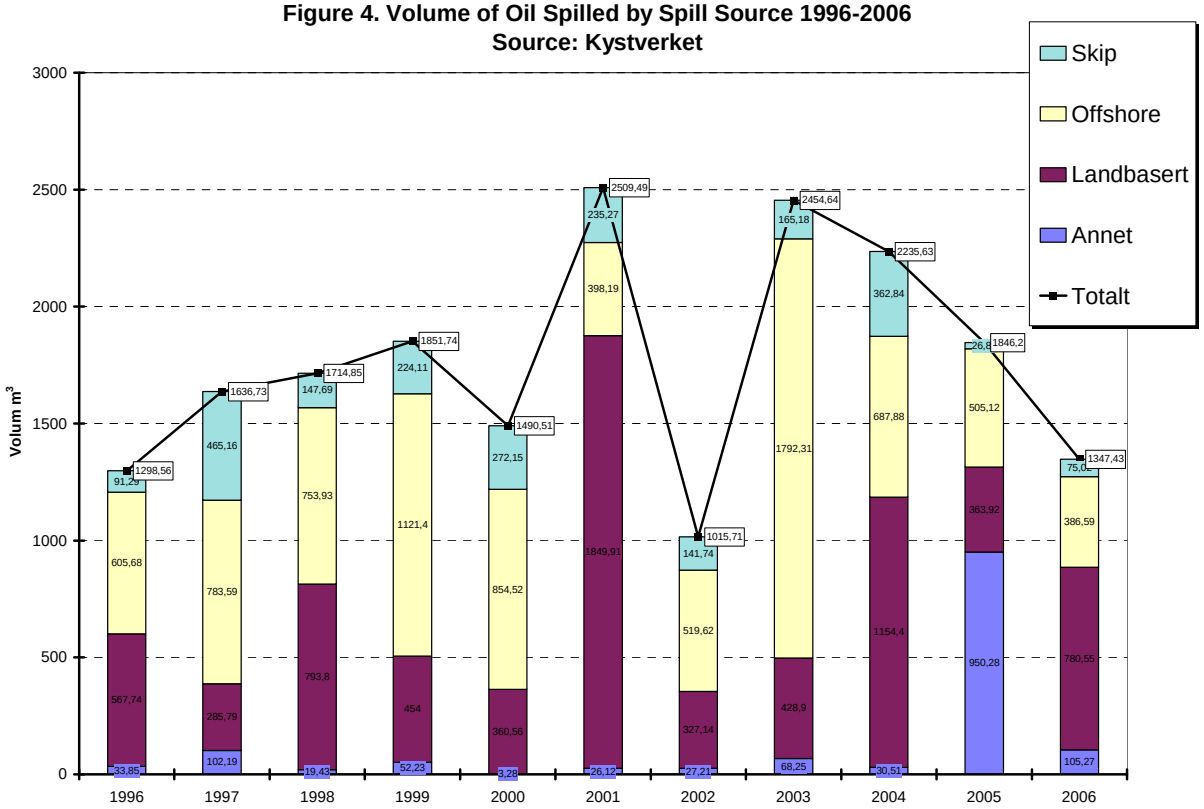


Figure 4. Volume of Oil Spilled by Spill Source 1996-2006
Source: Kystverket



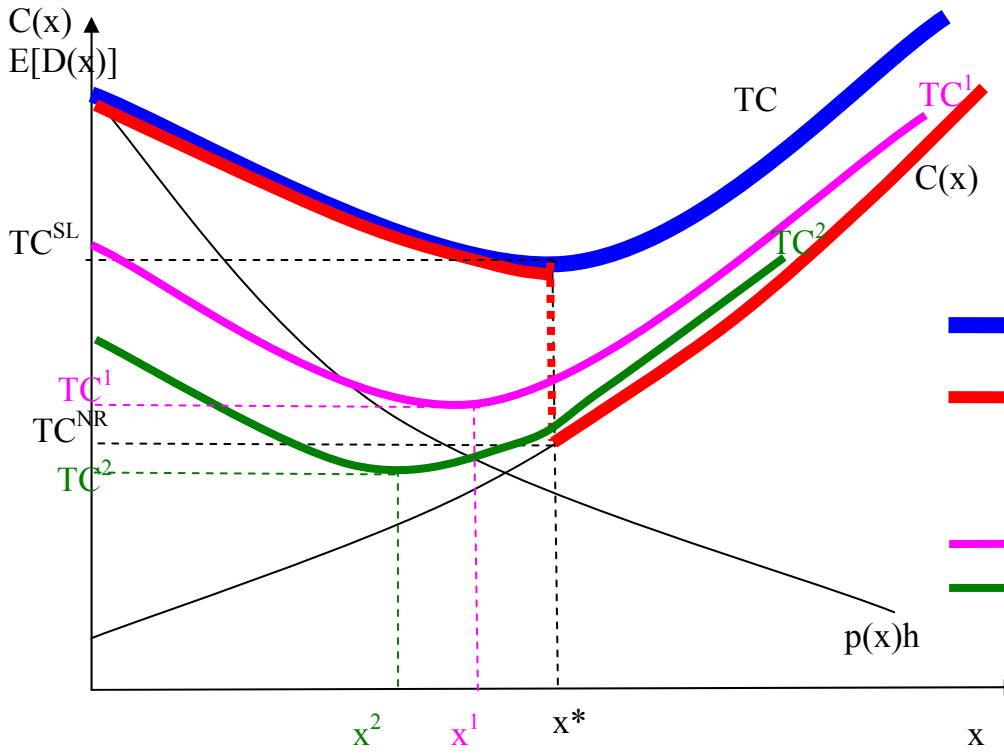


Figure 5
Total cost of care under 2 liability regimes

Cost under strict liability

Cost under negligence

Cost under insolvency

$q > q_c$

$q < q_c$

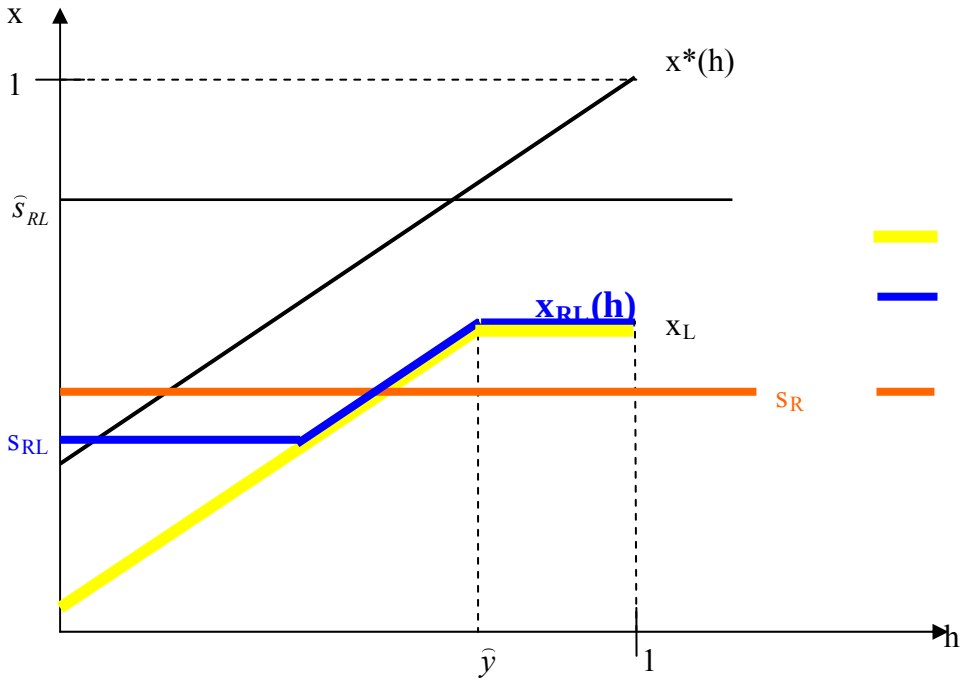


Figure 6
Liability vs regulation: Cost Efficiency (based on Shavell 1984b)

Liability x_L

Regulation+liability $s_{RL} + x_{RL}(h)$

Regulation s_R

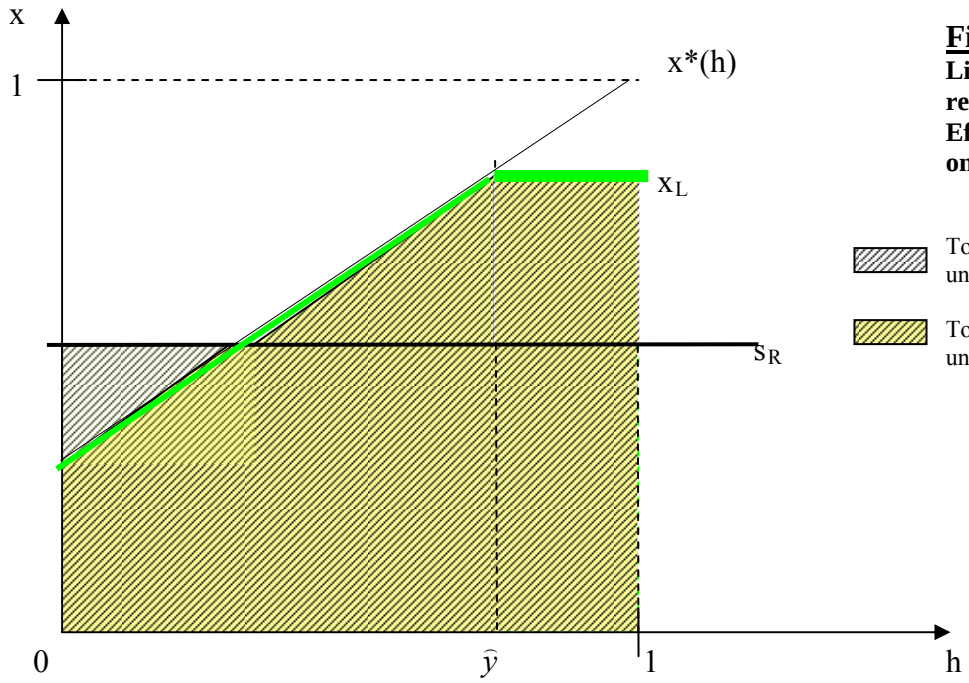


Figure 7
Liability vs regulation: Cost Efficiency (based on Schmitz 2000)

Appendix

1. The due care standard in the long run (based on Shavell 1984a and Polinsky 1980)

We make use of the first order condition (2) $P(ny) = C'(y)$ and insert it in expressions (5) and (6). We obtain the following expression:

$C'(y)\,y - C(y) - K = 0$ where K is a constant.

By total differentiation

$$C''_{yy} \cdot y \cdot dy - dK = 0$$

$$\frac{dy}{dK} = \frac{1}{C''_{yy} \cdot y}, \text{ and } \frac{dy}{dK} > 0 \text{ as } C''(y) > 0.$$

Comparing the zero profit conditions under the strict liability and negligence rules it is obvious that $K^{SL} > K^{NR}$ implying $y^* > y^0$.

Inserting the optimal values of y and n in expression (2) gives:

- under strict liability $P(n^* y^*) = C'(y^*)$,
- under negligence $P(n^0 y^0) = C'(y^0)$.

$C''(y) > 0$ and $y^* > y^0$ imply that $C'(y^*) > C'(y^0)$ and consequently $P(n^* y^*) > P(n^0 y^0)$.

From $n^* y^* < n^0 y^0$ and $y^* > y^0$ it follows that $n^0 > n^*$.

2. Combined use of regulation and liability (based on Schmitz (2000))

a) firms' homogeneity with regard to wealth

We demonstrate that the total cost of the joint use of direct regulation and liability is not welfare-improving given the same wealth constraint for all injurers and given $s < x^*(qy)$.

The total cost under the joint use is higher that the total cost under liability alone. It is explicitly assumed in the model that no polluter will choose a higher level of precaution than the first best level $x^*(h)$ because the cost of care increases in the level of care. In fact, polluters will rather choose to take lower care than x^*. Thus, in all the outcomes except the first best one, the care level will be suboptimal. Using expressions (9) on p. 12 and (13) on p. 16, $s_R = x^*(E[h]) < x^*(h)$ implies that $E[h] < h$.

$$TC_J(s_R, y) = \int_0^{C'(s)} (C(s_R) + (1 - s_R)h)dF(h) + \int_{C'(s)}^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h) +$$

$$+ \int_{qy}^{1} (C(x^*(qy)) + (1 - x^*(qy))h)dF(h) > \int_0^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h) +$$

$$+ \int_{qy}^{1} (C(x^*(qy)) + (1 - x^*(qy))h)dF(h) = TC_L(y) \Rightarrow$$

$$\int_0^{E[h]} (C(s_R) + (1 - s_R)h)dF(h) + \int_{E[h]}^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h) > \int_o^{qy} (C(x^*(h)) + (1 - x^*(h))h)dF(h)$$

b) firms' heterogeneity with regard to wealth

To get the threshold value of $\hat{\pi}$ the total cost of using regulation only should be equal to the total cost of imposing liability:

$$\hat{\pi}\, TC_L(y_{poor}) + (1 - \hat{\pi})\, TC_L(y_{rich}) = TC_R(s_R) \qquad (17)$$

$$\hat{\pi} = \frac{TC_R(s_R) - TC_L(y_{rich})}{TC_L(y_{poor}) - TC_L(y_{rich})}$$

To prove that $\hat{\pi} \in [0, 1]$ we show $TC_R(s_R) < TC_L(y_{poor})$:

$$TC_R(s_R) = \int_0^{qy_{poor}} (C(s_R) + (1 - s_R)h)dF(h) + \int_{qy_{poor}}^{1} (C(s_R) + (1 - s_R)h)dF(h) < \qquad (18)$$

$$< TC_L(y_{poor}) = \int_0^{qy_{poor}} (C(x^*(h)) + (1 - x^*(h))h)dF(h) + \int_{qy_{poor}}^{1} (C(x^*(qy_{poor})) + (1 - x^*(qy_{poor}))h)dF(h)$$

The proof is identical to the one in the previous section 2a).

We prove first that $C(s_R) + (1 - s_R)\, h < C(x^*(h)) + (1 - x^*(h))\, h$.

$s_R = x^*(E[h]) < x^*(h)$. The total cost is decreasing for all $x < x^*(h)$.

Using the same reasoning, $C(s_R) + (1 - s_R)\, h < C(x^*(qy_{poor})) + (1 - x^*(qy_{poor}))\, h$.

We have to show that $x^*(qy_{poor}) < s_R = x^*(E[h])$. In the model it is assumed that $y_{poor} < \hat{y}$, where $\hat{y}$ is the threshold value. It can be proved that for income levels exceeding $\hat{y}$, in particular, $\frac{E[h]}{q} > \hat{y}$ liability is preferable.

$TC_L(\frac{E[h]}{q}) < TC_R(s_R)$

$TC_L(\frac{E[h]}{q})$

$$= \int_0^{E[h]} (C(x^*(h)) + (1 - x^*(h))h)dF(h) + \int_{E[h]}^{1} (C(x^*(E[h])) + (1 - x^*(E[h]))h)dF(h) <$$

$$< \int_0^{1} (C(x^*(E[h]) + (1 - x^*(E[h])h)dF(h) \qquad (19)$$

which holds because $x^*(E[h]) < x^*(h)$. Therefore, $y_{poor} < \hat{y} < \frac{E[h]}{q}$.

We show that if most people are poor, so that $\pi > \hat{\pi}$, the total cost of using both measures is lower than the cost of exclusive use of regulation.

The total cost under combination of regulation and liability:

$\pi TC_R(s_R) + (1-\pi)TC_J(s, y_{rich})$

The total cost under regulation given the optimal standard s_R:

$$TC_R(s_R) = \int_0^{1} (C(s_R) + (1 - s_R)h)dF(h)$$

By expressions (15) and (16) on p. 18:

$$\int_0^{1} (C(x^*(E[h]) + (1 - x^*(E[h])h)dF(h) > \int_o^{E[h]} (C(x^*(E[h])) + (1 - x^*(E[h])h)dF(h) +$$

$$\int_{E[h]}^{qy_{rich}} (C(x^*(h)) + (1 - x^*(h))h)dF(h) + \int_{qy_{rich}}^{1} (C(x^*(qy_{rich})) + (1 - x^*(qy_{rich}))h)dF(h)$$

Alternatively,

$$\int_{E[h]}^{qy_{rich}} (C(x^*(E[h]) + (1 - x^*(E[h])h)dF(h) - C(x^*(h)) - (1 - x^*(h))h)dF(h) + \qquad (20)$$

$$+ \int_{qy_{rich}}^{1} (C(x^*(E[h]) + (1 - x^*(E[h])h)dF(h) - C(x^*(qy_{rich})) - (1 - x^*(qy_{rich}))h)dF(h) > 0$$

We assume that the income of rich individuals is above the average such that $y_{rich} > \frac{E[h]}{q}$,

consequently $x^*(E[h]) < x^*(qy_{rich}) < x^*(h)$. Given that, expression (20) is strictly positive, or

$TC_R(s_R) > \pi TC_R(s_R) + (1-\pi)TC_J(s, y_{rich})$. Therefore, the combination of direct regulation and liability is less costly than pure regulation.